Final Biological Assessment Report

Dardenne Creek

St. Charles County, Missouri

Fall 2008 & Spring 2009 Sample Seasons

Prepared for:

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Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch

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1.0 Introduction

At the request of the Water Protection Program (**WPP**), the Environmental Services Program's (**ESP**) Water Quality Monitoring Section (**WQMS**) conducted a biological assessment of Dardenne Creek as a follow-up to two studies conducted in this reach in 2002 and 2005. Dave Michaelson and Brian Nodine of the WQMS collected macroinvertebrate and water quality samples from seven stations on Dardenne Creek in September 2008 and April 2009. Michaelson and Nodine also performed benthic sediment analysis on these Dardenne Creek stations as well as eight stations on five control streams in fall 2008. Carl Wakefield and Brandy Bergthold collected water quality and macroinvertebrate samples from these control streams in fall 2008 and spring 2009.

2.0 Project History

Dardenne Creek's middle reach, where land use is changing from rural to suburban, has been the focus of past Department of Natural Resources studies (Campbell 2002, Michaelson 2007). The Department's Water Protection Program first requested a biological assessment of Dardenne Creek be conducted in 2002 to address potential water quality concerns related to increasing levels of development in the watershed. Based on a portion of that study's findings--specifically, that the benthic substrate of the downstream study reach was significantly covered with fine sediment--the department added Dardenne Creek to the 2002 303(d) List of Impaired Waters for unknown pollutants originating from urban and rural nonpoint source pollution.

The 2002 study included macroinvertebrate community, benthic sediment, and water quality analyses at six stations on Dardenne Creek and two stations on North Fork Cuivre River (a local control stream). Water quality analysis included a standard suite of chemistry parameters (described in Section 6.3) as well as testing for fecal coliform. Biological metrics tended to increase on Dardenne Creek from upstream to downstream with the exception of Station 4 near the confluence of Little Dardenne Creek (please see Appendix A, map 1). One recommendation of the 2002 study was to collect additional samples at a later date to determine whether the seemingly anomalous decline observed at this station was due to some factor associated with the Little Dardenne Creek subwatershed (Campbell 2002).

In September 2005 a second biological assessment study (Michaelson 2007) was initiated to address recommendations in the 2002 report. This study repeated macroinvertebrate and water quality sampling at Station 3 and Station 4; in addition Station 4.1 was established immediately upstream of the Little Dardenne Creek confluence as well as a station on Little Dardenne Creek itself. Water quality analyses did not indicate any notable differences in Dardenne Creek upstream versus downstream of the confluence, nor was water quality in Little Dardenne Creek sufficiently different to suggest it was the cause of the macroinvertebrate community anomaly observed in the 2002 study. The biological component of the follow-up study was judged to be inconclusive, however, due to low water levels during the fall 2005 sample season that extended into the winter months preceding spring 2006 sampling. A recommendation was made in the 2005/2006 study to conduct another biological assessment at some point in the future following at least two years of near-average precipitation (Michaelson 2007).

3.0 Study Area

Dardenne Creek originates southwest of Foristell in eastern Warren County and flows generally east through a rural St. Charles County watershed, which is interspersed with housing subdivisions. The creek downstream of Highway 40-61 is more heavily impacted, including reaches that appear to have been channelized and receive a substantial amount of urban runoff. Sample stations for this study are located in reaches of class “P” waters (those that flow permanently, even in periods of drought) and class “C” waters (those in which flow ceases in dry periods, but permanent pools remain to support aquatic life). The Missouri Water Quality Standards (MDNR 2008) state the beneficial use designations for the Class “P” portion of the study area of Dardenne Creek to be “protection of warm water aquatic life and human health--fish consumption,” “livestock and wildlife watering,” “whole body contact (B),” which includes waters that are not open to the public or regularly used for swimming, and “secondary contact recreation,” which includes recreational activities that may result in incidental or accidental contact with the water and the probability of ingesting appreciable quantities of water is minimal. For the Class “C” portion of the study reach, beneficial uses on Dardenne Creek are “protection of warm water aquatic life and human health--fish consumption,” “livestock and wildlife watering,” and “whole body contact (B).” Permanent flow of this stream begins in Section 22, Township 46 North, and Range 2 East (MDNR 2008). Station 1 on Dardenne Creek is the only sample station classified with permanent flow, whereas Stations 2 through 6.1 are classified as class "C" waters.

Dardenne Creek is located within the Central Plains/Cuivre/Salt (**CPCS**) Ecological Drainage Unit (**EDU**). An EDU is a region in which biological communities and habitat conditions can be expected to be similar. Maps of the EDU and the local sampling locations can be found in Appendix A, map 2. Table 1 compares the land cover percentages from the Central Plains/Cuivre/Salt EDU and the 14-digit Hydrologic Unit Codes (**HUC**) that contain the reaches of this study’s sample stations. Percent land cover data were derived from Thematic Mapper satellite images from 2000-2004 and interpreted by the Missouri Resource Assessment Partnership (**MoRAP**).

Table 1
Percent Land Cover

Sample Location	HUC 14	Urban	Crops	Grassland	Forest	Wetland
CPCS EDU	N/A	3	42	29	19	--
Dardenne Ck.	07110009030001	3	28	23	39	2
Big Ck.	07110008040001	4	32	22	35	2
Hays Ck.	07110007030002	1	52	21	22	--
N. Fk. Cuivre R.	07110008010003	2	51	26	16	1
South R.	07110004030001	3	54	23	16	--
Sugar Ck.	07110008050001	2	23	19	52	--

The study area includes approximately 15 miles of Dardenne Creek located from the August A. Busch Conservation Area upstream to the Foristell Road bridge crossing, north of New Melle. With the exception of Station 6.1, the test stations listed below were used for previous biological assessment studies. The 2002 biological assessment was conducted as part of a joint project with the Missouri Department of Conservation (**MDC**). MDC personnel used Global Information Systems (**GIS**) software (e.g. ArcView®) to choose Dardenne Creek stream reaches in a stratified random manner to sample for fish; we used these same stations for biological assessment purposes. Little Dardenne Creek Station 1 and Dardenne Creek Station 4.1 were added in 2005 for the second study, however Little Dardenne Creek was not included in this study.

A total of five local control streams were used to assist in the evaluation of the Dardenne Creek stations (Appendix A, map 3). Each of these local control stations is rated Class "C" in Missouri's Water Quality Standards, and were used to help assess conditions among Dardenne Creek stations. A total of four control streams were selected in a manner similar to biological criteria reference streams and have no significant influence from permitted discharges.

The fifth control stream that was used for this study was South River, a biological criteria reference stream. Macroinvertebrate, water quality, and sediment cover estimation samples were collected at the historic sample site (see below). In addition to the historic sample site, three South River stations were sampled within the biological criteria reference reach for sediment only. These four South River stations were used to address possible longitudinal differences in sediment distribution and to provide a more diverse and robust data set for benthic fine sediment analysis.

Test Stations

Dardenne Creek Station 1 (no legal description) is located north of Lake 33 (also known as Kraut Run Lake) in the August A. Busch Conservation Area in St. Charles County. Universal Transverse Mercator (**UTM**) coordinates collected at the upstream boundary of the sample reach are UTMN 4290156, UTME 694110

Dardenne Creek Station 2 (NE ¼ sec. 21, T. 46 N., R. 2 E.) is located downstream of the State Road DD bridge in St. Charles County. UTM coordinates, measured approximately

300 yards upstream of the Busch Conservation Area property boundary, are UTMN 4289579, UTME 691487.

Dardenne Creek Station 3 (Survey 418, T. 46 N., R. 2 E.) is located downstream of the Hopewell Road bridge in St. Charles County. UTM coordinates were taken at the first riffle downstream from a Missouri Department of Conservation fish sampling station marker (UTMN 4290142, UTME 689710).

Dardenne Creek Station 4 (Survey 891, T. 46 N., R. 2 E.) is located upstream of the Hopewell Road bridge in St. Charles County. UTM coordinates were taken at the MDC fish sampling station marker (UTMN 4290686, UTME 688210).

Dardenne Creek Station 4.1 (Survey 891, T. 46 N., R. 2 E.) is located upstream of the Little Dardenne Creek confluence in St. Charles County. UTM coordinates at the downstream terminus of the sample reach are UTMN 4290702, UTME 687836.

Dardenne Creek Station 5 (NW ¼ sec. 24 and NE ¼ sec. 23, Survey 1807, T. 46 N., R. 1 E.) is located downstream of the State Road Z bridge in St. Charles County. UTM coordinates were taken at the MDC fish sampling station marker (UTMN 4289409, UTME 684966).

Dardenne Creek Station 6.1 (E ½ sec. 22, T. 46 N., R. 1 E.) is located downstream of the Foristell Road bridge in St. Charles County. UTM coordinates were taken downstream of a small wet-weather tributary that entered from the right descending bank downstream of the bridge (UTMN 4288823, UTME 683294).

Biological Criteria Reference Station
South River Station 4 (NE ¼ sec. 31, T. 58 N., R. 5 W.) is located upstream of the County Road 403 bridge in Marion County. UTM coordinates at the downstream terminus of the sample reach are UTMN 4404786, UTME 628341.

Local Control Stations
North Fork Cuivre River Station 1 (Section Line 13/14, T. 51 N., R. 3 W.) is a control stream located downstream of the County Road 325 bridge in Pike County. UTM coordinates were taken immediately downstream of the bridge (UTMN 4339803, UTME 655188).

Big Creek Station 1 (NW ¼ sec. 34, T. 48 N., R. 2 W.) is a control stream located upstream of the North Church Rock Road bridge in Warren County. UTM coordinates at the downstream terminus of the sample reach are UTMN 4305582, UTME 662317.

Hays Creek Station 1 (NW ¼ sec. 29, T. 54 N., R. 5 W.) is a control stream located upstream of the Bridgewater Lane bridge in Ralls County. UTM coordinates at the downstream terminus of the sample reach are UTMN 4366398, UTME 629917.

Sugar Creek Station 1 (NW ¼ sec. 31, T. 50 N., R. 1 E.) is a control stream located upstream of State Road KK within Cuivre River State Park in Lincoln County. UTM coordinates at the downstream terminus of the sample reach are UTMN 4325175, UTME 677738.

South River Station 1 (SW ¼ sec. 29, T. 58 N., R. 5 W.) is a sediment control station located downstream of County Road 402 in Marion County. This station was used only for the measurement of sediment; no macroinvertebrates or water quality samples were collected from South River Stations 1, 2, or 3. GPS coordinates were not collected at South River Stations 1 or 2, but UTM coordinates estimated using ArcMap® at the County Road 402 bridge are UTMN 4405831, UTME 629504.

South River Station 2 (SE ¼ sec. 30, T. 58 N., R. 5 W.) is a sediment control station located upstream of a farm machinery crossing, approximately 0.5 miles west of the County Road 402 bridge in Marion County. Estimated UTM coordinates at the crossing are UTMN 4405694, UTME 628865.

South River Station 3 (NW ¼ NE ¼ sec. 31, T. 58 N., R. 5 W.) is a sediment control station located downstream of the County Road 403 bridge in Marion County. UTM coordinates at the upstream terminus of the sample reach are UTMN 4404786, UTME 628341.

4.0 Objectives

The current study essentially repeats the 2002 study with the exception that the fecal coliform portion was eliminated. Macroinvertebrate community composition, water quality, and benthic sediment coverage were assessed at the same five downstream stations on Dardenne Creek plus the addition of Station 4.1 upstream of Little Dardenne Creek added in 2005/2006. Since the 2002 study, the property used to access Station 6 changed ownership; the new landowners could not be located in a timely manner prior to fall 2008 sampling, so Station 6.1 was established a short distance upstream.

The following objectives will be addressed: 1) to determine if Dardenne Creek supports its beneficial use designation of supporting aquatic life based on biological criteria calculated from reference stream macroinvertebrate data in the Central Plains/Cuivre/Salt Ecological Drainage Unit; 2) whether aquatic life in Dardenne Creek is impaired relative to local control streams; 3) whether nutrient water quality parameters differ between Dardenne Creek and the local control stream; and 4) whether benthic sediment coverage is greater in Dardenne Creek than in local control streams.

5.0 Null Hypotheses

1) The macroinvertebrate community will not differ longitudinally among Dardenne Creek study sites.

2) The Dardenne Creek macroinvertebrate community will not differ from that of reference streams within the Central Plains/Cuivre/Salt Ecological Drainage Unit.

3) The Dardenne Creek macroinvertebrate community will not differ from that of local control streams.

4) Water quality and nutrient parameters will not differ longitudinally among Dardenne Creek study sites.

5) Dardenne Creek benthic sediment deposits will not be statistically different than biological reference or local control streams.

6.0 Methods

6.1 Macroinvertebrate Collection and Analysis

A standardized sample collection procedure was followed as described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (MDNR 2003d). Three standard habitats--flowing water over coarse substrate (riffles), depositional substrate in non-flowing water, and rootmat at the stream edge--were sampled at all Dardenne Creek and control locations.

A standardized sample analysis procedure was followed as described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure. The following four metrics were used: 1) Taxa Richness (TR); 2) total number of taxa in the orders Ephemeroptera, Plecoptera, and Trichoptera (EPTT); 3) Biotic Index (BI); and 4) Shannon Diversity Index (SDI). These metrics were scored and combined to form the Macroinvertebrate Stream Condition Index (MSCI). Macroinvertebrate Stream Condition Indices between 20-16 qualify as fully biologically supporting, between 14-10 are partially supporting, and 8-4 are considered non-supporting of aquatic life. The multi-habitat macroinvertebrate data are presented in Appendix B as laboratory bench sheets.

Macroinvertebrate data were analyzed in the following specific ways. Comparisons were made among reaches longitudinally. This comparison addresses influences that may result from differential sediment deposition and possible scouring effects among sites within the study reach. Data are summarized and presented in tabular format comparing means of the four standard metrics and other parameters at each of the stations sampled in this project.

6.2 Macroinvertebrate Laboratory Processing

Laboratory processing was consistent with the description in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (MDNR 2003d). Each sample was processed under 10x magnification to remove a habitat-specific target number of individuals from debris. Individuals were identified to standard taxonomic levels (MDNR 2005b) and enumerated.

6.3 Physicochemical Data Collection and Analysis

During the fall 2008 and spring 2009 sample seasons, *in situ* water quality measurements were recorded at all stations where macroinvertebrates were collected. Field measurements included temperature (MDNR 2003a), dissolved oxygen (MDNR 2002), conductivity (MDNR 2003e), turbidity (MDNR 2005a), and pH (MDNR 2001). Additionally, water samples were collected by the WQMS and analyzed by ESP's Chemical Analysis Section for chloride, total phosphorus, ammonia-N, nitrite+nitrate-N, and total nitrogen (all parameters reported in mg/L). Procedures outlined in Field Sheet and Chain of Custody Record (MDNR 2005c) and Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2009) were followed when collecting water quality samples. Stream velocity was measured at each station where practicable during the study using a Marsh-McBirney Flo-Mate™ Model 2000 flow meter. Discharge was calculated per the methods in the Standard Operating Procedure MDNR-FSS-113, Flow Measurement in Open Channels (MDNR 2003b).

Physicochemical data were summarized and presented in tabular form for comparison among stations.

6.4 Benthic Fine Sediment Measurement

Two methods were used to measure the percentage of instream benthic fine sediment deposits. The first, a visual estimation method, is similar to that used by Campbell (2002) and described in the draft Standard Operating Procedures (included in the Dardenne Creek Study Plan, Appendix C). Within each sample reach, percent fine sediment coverage was visually estimated within a metal quadrat (fine sediment is considered to be particle size less than 2mm). The readings were made at the upper margins of pools or the lower margins of riffle/run habitat where stream velocity decreases and fine sediment tends to drop out of the water column and collect on the streambed. Velocity was measured at each of the grids prior to taking the sediment readings. If the velocity was less than 0.5 feet per second and the depth was less than 2.5 feet, the area was then used to obtain the sediment estimate reading.

Each stream reach contained three sample grids. A sample grid consists of six contiguous transects across the stream (see Figure 1). A transect was established by stretching a tape measure from bank to bank. Transects were always established and sampled in a downstream to upstream direction. One sample quadrat (25 cm X 25 cm) was placed directly on the substrate within each of the six transects using a random number that equated to one-foot increments (see Figure 2). The lower left corner of the quadrat was placed on the random foot increment. Two investigators visually estimated the percentage of the stream bottom covered by fine sediment within each quadrat. If the sediment estimates by the two investigators were within ten percent of each other, the estimate was accepted. If the estimates differed by more than ten percent, the investigators repeated the process until the estimates were within the acceptable margin of error. An average of the two estimates was then recorded and used for analysis.

In addition to using the quadrat described in the draft SOP, a second method was used which incorporated the use of a 60 cm X 60 cm United States Forest Service Pebble Count Sampling Frame (Rickly Hydrological Company, Columbus, OH 43219) (a photograph is included in the Dardenne Creek Study Plan, Appendix C). The visual estimation method was used first at each transect using the quadrat as described in the draft SOP. Upon completion of the visual measurement, a separate set of random numbers were generated for use with the pebble count frame.

Figure 1: Sediment Estimation Grids within a Macroinvertebrate Sample Station Reach

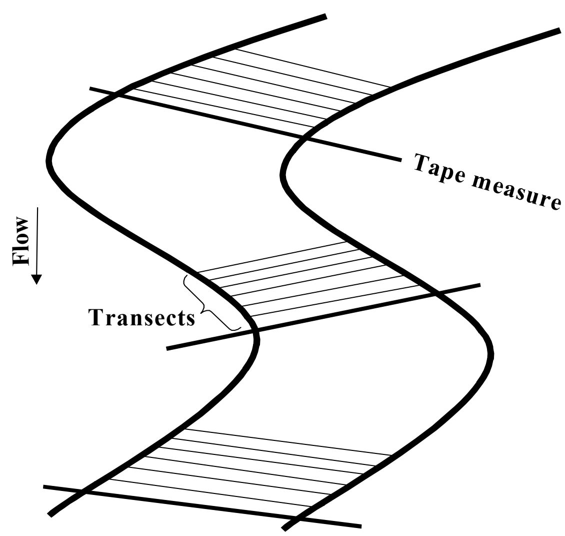
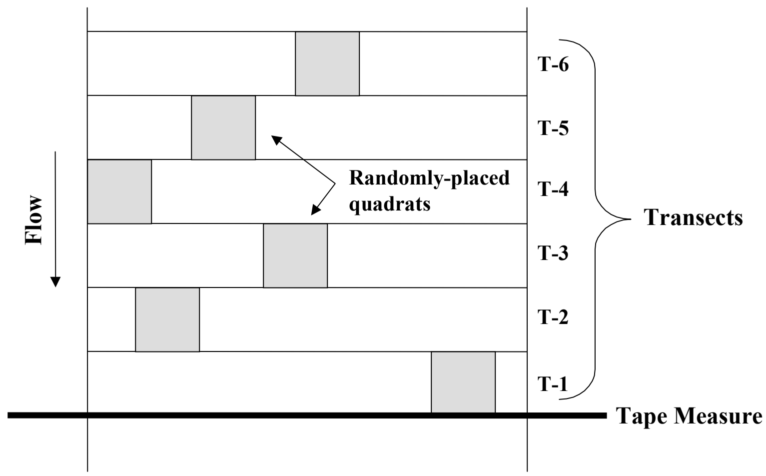


Figure 2: Sediment Sample Grid



This pebble count frame features an adjustable grid of elastic bands that can subdivide the sample area. As with the draft SOP, two investigators were used to measure sediment coverage in a stratified random study sampling design. With the pebble count frame, however, the particle size beneath each of the 25 intersections of the bands was evaluated. The number of intersections that occurred over benthic sediment <2.0 mm in diameter was recorded and converted to percent coverage of fine sediment ($\frac{x}{25} \cdot 100$).

This percent coverage was analyzed per the methods described in the draft SOP (included in the Dardenne Creek Study Plan, Appendix C) to determine whether a statistically significant difference ($p < 0.05$) exists among Dardenne Creek stations compared to one another as well as to local control or biological criteria reference sites. The statistical program SigmaStat® was used to conduct statistical comparisons between two groups. The t-test was selected for each comparison and the data set tested for normality. For each comparison, however, the normality test failed which necessitated the use of the nonparametric Mann-Whitney Rank Sum Test. Statistical comparisons also were conducted to compare the two methods with one another to determine how closely they were in agreement with one another.

6.5 Quality Assurance/Quality Control (QA/QC)

6.5.1 Field Meters

All field meters used to collect water quality parameters were maintained in accordance with the Standard Operating Procedure MDNR-ESP-213, Quality Control Procedures for Checking Water Quality Field Instruments (MDNR 2005d).

6.5.2 Biological Samples

Approximately 3% of macroinvertebrate samples were checked for accuracy of organism removal from sample debris. These tasks were performed consistent with those methods found in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (MDNR 2003d).

6.5.3 Biological Data Entry

All macroinvertebrate data were entered into the WQMS macroinvertebrate database consistent with the Standard Operating Procedure MDNR-WQMS-214, Quality Control Procedures for Data Processing (MDNR 2003c).

7.0 Data Results

7.1 Physicochemical Data

Flow and non-nutrient water quality parameters of Dardenne Creek sites sampled in fall 2008 are presented in Table 2, with spring 2009 data in Table 3. Discharge was higher among the downstream three Dardenne Creek stations than the upper stations during both field seasons. Fall discharge measurements of the upstream portion of the study reach, Dardenne Creek Stations 4-6.1, were lower than all the remaining stations sampled in this study. In spring 2009, however, the upstream Dardenne Creek stations had discharge measurements that were comparable to the smaller control streams, whereas the downstream stations (Stations 1-4 in this case) were similar to South River and North Fork Cuivre River, which were the two larger control streams. Little Dardenne Creek had sufficient flow in spring to make a notable increase in discharge between Station 4.1, which was upstream of the confluence and Station 4, which was downstream. Among Dardenne Creek stations, conductivity was highest at Station 6.1 in fall but lowest in spring. Conductivity at each of the control stations was similar to or higher than Dardenne Creek during both sample seasons. Temperature was similar among stations in the fall, with the exception of South River and Sugar Creek, which were sampled a week later than Dardenne Creek and early in the day. Spring temperatures were more variable among stations, even within Dardenne Creek. A six degree difference existed between the warmest and coolest Dardenne Creek temperatures, which may be partly explained by the time of day when the samples were collected. Turbidity was slightly higher at the three downstream Dardenne Creek stations and, although turbidity tended to be higher in spring, none of the stations included in this study had unusually high turbidity readings. With the exception of Station 1 we were unable to measure dissolved oxygen at Dardenne Creek and North Fork Cuivre River due to meter failure in fall. Water quality parameters for the remaining control stations were collected one week after sampling Dardenne Creek. Spring dissolved oxygen was similar among Dardenne Creek stations, with Station 5 being higher than the remaining sites. Of the control stations, South River had the lowest dissolved oxygen with 8.64 mg/L and Sugar Creek with 15.12 mg/L had the highest. There was little difference among pH readings during either field season.

Table 2
Fall 2008 Flow and *In situ* Water Quality Measurements

	Parameter					
Station	Flow (cfs)	Temperature (˚C)	Dissolved O_2 (mg/L)	Conductivity (µS/cm)	pH	Turbidity (NTU)
DC #1	9.5	20.0	6.90	381	7.68	2.51
DC #2	7.7	21.0	N/A	375	7.90	1.38
DC #3	4.9	22.0	N/A	374	7.89	1.98
DC #4	0.8	19.5	N/A	374	7.45	<1.00
DC #4.1	0.5	20.5	N/A	368	7.80	<1.00
DC #5	0.4	23.0	N/A	387	7.83	1.15
DC #6.1	0.6	23.0	N/A	440	7.78	1.13
Big Ck. #1	2.7	19.8	8.08	445	7.88	<1.00
Hays Ck. #1	1.2	18.0	5.42	440	7.46	<1.00
NFCR #1	3.2	23.0	N/A	447	7.90	1.10
South R. #4	9.4	12.7	7.82	550	7.79	1.90
Sugar Ck. #1	2.9	15.8	7.59	554	7.74	<1.00

N/A = Data not available due to equipment malfunction

Table 3
Spring 2009 Flow and *In situ* Water Quality Measurements

Station	Flow (cfs)	Temperature (˚C)	Dissolved O_2 (mg/L)	Conductivity (µS/cm)	pH	Turbidity (NTU)
DC #1	12.5	8.0	10.6	433	7.9	3.17
DC #2	12.2	10.5	10.6	423	7.6	1.84
DC #3	8.1	10.0	12.6	414	7.9	2.40
DC #4	12.2	8.0	11.8	423	7.9	1.74
DC #4.1	4.3	10.0	12.3	416	8.2	1.28
DC #5	2.5	12.0	15.3	417	8.6	1.55
DC #6.1	1.8	14.0	12.1	398	8.2	1.49
Big Ck. #1	4.9	11.5	9.95	564	8.0	1.50
Hays Ck. #1	2.0	13.1	11.61	421	7.9	1.31
NFCR #1	10.9	15.6	13.2	442	8.2	4.86
South R. #1	11.6	12.5	8.64	539	8.2	6.53
Sugar Ck. #1	3.1	12.6	15.12	568	8.4	1.81

Fall nutrient concentrations as well as chloride concentrations are presented in Table 4. Among Dardenne Creek stations, these parameters differed very little. Total phosphorus and ammonia as nitrogen all were either below detectable limits or analytical practical quantitation limits. Although nitrite+nitrate-nitrogen and total nitrogen were higher at Station 1, these nutrient concentrations were not substantially higher than the remaining stations. Among the control stations, South River had the highest nutrient and chloride levels. Nitrite+nitrate-nitrogen, total nitrogen, and chloride concentrations all were higher at South River than any of the remaining control or Dardenne Creek stations.

Table 4
Fall 2008 Dardenne Creek and Control Stream Nutrient Concentrations

	Parameter (mg/L)				
Station	NH_3-N	NO_2+NO_3-N	Total Nitrogen	Total Phosphorus	Chloride
DC #1	*	0.28	0.53	0.04**	11.3
DC #2	*	0.15	0.31	0.03**	11.7
DC #3	*	0.09	0.34	0.03**	10.9
DC #4	*	0.08	0.22	0.03**	9.57
DC #4.1	*	0.07	0.22	0.03**	10.4
DC #5	*	0.16	0.38	0.04**	13.0
DC #6.1	*	0.18	0.44	0.04**	12.7
Big Ck. #1	*	0.02**	0.14	0.04**	15.9
Hays Ck. #1	*	0.07	0.17	0.05**	5.2
NFCR #1	*	1.58	1.97	0.06	14.3
South R. #4	*	4.53	4.35	0.06	28.7
Sugar Ck. #1	*	0.55	0.63	0.06	12.9

*Below detectable limits
**Estimated value, detected below Practical Quantitation Limits

Spring nutrient as well as chloride and non-filterable residue (**NFR**) concentrations are presented in Table 5. As was the case with fall samples, these analytes were similar among Dardenne Creek stations. Nutrient values were similar to or lower in spring compared to fall, but chloride concentrations tended to be higher for all stations in spring. Total phosphorus and ammonia as nitrogen were below detectable limits for all stations, including the controls, except at South River. In this single case, although there was a detectable concentration of phosphorus at the South River station, it was sufficiently low to be considered an estimated value. As with fall, South River had the highest concentrations of nitrite+nitrate-nitrogen and total nitrogen during spring, but chloride was similar to several other control stations. With the exception of Hays Creek, chloride tended to be higher among the control stations compared to Dardenne Creek. Little variation existed among spring Dardenne Creek chloride readings.

Table 5
Spring 2009 Dardenne Creek and Control Stream Watershed Nutrient Concentrations

	Parameter (mg/L)					
Station	NH_3-N	NO_2+NO_3-N	Total Nitrogen	Total Phosphorus	Chloride	NFR
DC #1	*	0.14	0.30	*	19.4	*
DC #2	*	0.07	0.27	*	19.6	*
DC #3	*	0.03**	0.24	*	20.2	*
DC #4	*	0.05**	0.24	*	19.3	*
DC #4.1	*	0.03**	0.22	*	17.7	*
DC #5	*	0.10	0.30	*	19.2	*
DC #6.1	*	0.14	0.40	*	18.2	*
Big Ck. #1	*	*	0.16	*	35.4	*
Hays Ck. #1	*	0.10	0.23	*	10.2	*
NFCR #1	*	0.76	1.00	*	22.1	*
South R. #1	*	3.11	3.24	0.01**	27.9	*
Sugar Ck. #1	*	0.19	0.34	*	26.7	*

*Below detectable limits
**Estimated value, detected below Practical Quantitation Limits

7.2 Biological Assessment

7.2.1 Dardenne Creek Longitudinal Assessment

Metrics and scores calculated for Dardenne Creek were compared to biological criteria based on reference sites from the Central Plains/Cuivre/Salt EDU. Criteria for the fall (Table 6) and spring (Table 7) sample season were used to assess the overall health of the aquatic communities within the EDU.

Table 6
Biological Criteria for Warm Water Reference Streams in the Central Plains/Cuivre/Salt EDU, Fall Season

	Score = 5	Score = 3	Score = 1
TR	>73	73-37	<37
EPTT	>18	18-9	<9
BI	<6.3	6.3-8.1	>8.1
SDI	>2.95	2.95-1.47	<1.47

Table 7
Biological Criteria for Warm Water Reference Streams in the Central Plains/Cuivre/Salt EDU, Spring Season

	Score = 5	Score = 3	Score = 1
TR	>77	77-39	<39
EPTT	>17	17-9	<9
BI	<6.3	6.3-8.1	>8.1
SDI	>3.21	3.21-1.61	<1.61

Fall biological metrics were consistent among Dardenne Creek stations, with none but Station 6.1 achieving fully supporting status (Table 8). Unlike the 2002 study, there was no general longitudinal increase in biological metrics from upstream to downstream and the uppermost station unexpectedly had the highest Taxa Richness and Shannon Diversity Index values. Of the five control stations, only two--Big Creek and South River--had fully supporting scores. Each of these stations had individual biological metric patterns similar to Dardenne Creek 6.1 with Taxa Richness and Shannon Diversity Index having the highest values and scores. None of the stations in this study had sufficiently high EPT Taxa values (>18) to achieve the highest score for this metric; all stations were well short of this threshold with the highest number of EPT Taxa (15) occurring at Dardenne Creek Stations 2, 6.1, and Big Creek.

Table 8
Metric Values and Scores for Dardenne Creek and Control Streams, Fall 2008 Season, Using Central Plains/Cuivre/Salt Biological Criteria Reference Data

Site	TR	EPTT	BI	SDI	MSCI	Support
DC #1 Value	70	10	6.4	2.91		
DC #1 Score	3	3	3	3	12	**Partial**
DC #2 Value	71	15	6.4	2.95		
DC #2 Score	3	3	3	3	12	**Partial**
DC #3 Value	63	10	6.3	3.02		
DC #3 Score	3	3	3	5	14	**Partial**
DC #4 Value	65	13	6.4	2.87		
DC #4 Score	3	3	3	3	12	**Partial**
DC #4.1 Value	59	13	6.5	2.76		
DC #4.1 Score	3	3	3	3	12	**Partial**
DC #5 Value	67	11	6.5	2.93		
DC #5 Score	3	3	3	3	12	**Partial**
DC #6.1 Value	80	15	6.8	3.19		
DC #6.1 Score	5	3	3	5	16	**Full**
Big Ck. #1 Value	76	15	6.6	3.25		
Big Ck. #1 Score	5	3	3	5	16	**Full**
Hays Ck. #1 Value	67	9	7.0	2.79		
Hays Ck. #1 Score	3	3	3	3	12	**Partial**
NFCR #1 Value	50	9	6.5	2.50		
NFCR #1 Score	3	3	3	3	12	**Partial**
South R. #4 Value	78	12	6.4	3.36		
South R. #4 Score	5	3	3	5	16	**Full**
Sugar Ck. #1 Value	67	10	6.6	2.97		
Sugar Ck. #1 Score	3	3	3	5	14	**Partial**

Dardenne Creek spring biological metrics tended to score higher than fall and all MSCI scores were at least somewhat higher (Table 9). Whereas only Station 6.1 achieved a fully supporting score in fall, five of the seven Dardenne Creek stations were fully supporting in spring. Dardenne Creek Station 4.1 was the only site to achieve the highest possible MSCI score of 20; of the remaining sites that were fully supporting, all had scores of 16. Of the five control streams, Big Creek and South River experienced a decline of MSCI scores from fall to spring, which resulted in the ranking of each to change from fully- to partially biologically supporting. MSCI scores of the remaining control stations improved slightly, but only Sugar Creek changed to fully biologically supporting. Unlike fall, at least some Dardenne Creek spring 2009 samples had the required number of EPT Taxa (>17) to attain the highest score for this metric. Dardenne Creek stations with the highest numbers of EPT Taxa (Stations 3, 4, and 4.1) occurred toward the middle of the study reach. Dardenne Creek Station 2 had 17 EPT Taxa, which is a single taxon less than what is required to reach the highest score for this metric. Sugar Creek was the only control station to reach the highest possible score for the EPT Taxa metric. For the Taxa Richness metric, only Dardenne Creek Stations 2 and 4.1 had sufficient values (>77) in spring to achieve an individual metric score of 5. Dardenne Creek Station 6.1 had 77 total taxa and needed one additional taxon to merit a score of 5 for this metric. Whereas all Dardenne Creek stations scored 5 for Biotic Index, only Dardenne Creek Stations 4.1 and 6.1 scored 5 for Shannon Diversity Index. Of the control stations, only Big Creek and South River failed to achieve a Biotic Index score of 5. Of the five controls, only South River scored 5 for the Shannon Diversity Index metric.

Table 9
Metric Values and Scores for Dardenne Creek and Control Streams, Spring 2009 Season, Using Central Plains/Cuivre/Salt Biological Criteria Reference Data

Site	TR	EPTT	BI	SDI	MSCI	Support
DC #1 Value	71	15	5.9	3.13		
DC #1 Score	3	3	5	3	14	**Partial**
DC #2 Value	81	17	5.8	3.17		
DC #2 Score	5	3	5	3	16	**Full**
DC #3 Value	71	20	5.9	3.14		
DC #3 Score	3	5	5	3	16	**Full**
DC #4 Value	69	18	5.6	2.95		
DC #4 Score	3	5	5	3	16	**Full**
DC #4.1 Value	83	21	5.9	3.27		
DC #4.1 Score	5	5	5	5	20	**Full**
DC #5 Value	68	15	6.2	3.04		
DC #5 Score	3	3	5	3	14	**Partial**
DC #6.1 Value	77	14	6.1	3.31		
DC #6.1 Score	3	3	5	5	16	**Full**

Big Ck. #1 Value	69	14	6.4	3.14		
Big Ck. #1 Score	3	3	3	3	12	**Partial**
Hays Ck. #1 Value	68	13	6.2	3.21		
Hays Ck. #1 Score	3	3	5	3	14	**Partial**
NFCR #1 Value	61	12	6.0	3.03		
NFCR #1 Score	3	3	5	3	14	**Partial**
South R. #1 Value	77	13	6.3	3.23		
South R. #1 Score	3	3	3	5	14	**Partial**
Sugar Ck. #1 Value	68	20	6.1	2.83		
Sugar Ck. #1 Score	3	5	5	3	16	**Full**

7.2.2 Dardenne Creek Macroinvertebrate Community Composition

Fall 2008 Macroinvertebrate Taxa Richness, EPT Taxa, and percent EPT for Dardenne Creek are presented in Table 10 and spring 2009 data are in Table 11. These tables also provide percent composition data for the five dominant macroinvertebrate families at each Dardenne Creek station. The percent relative abundance data were averaged from the sum of three macroinvertebrate habitats--coarse substrate, nonflow, and rootmat--sampled at each station.

Table 10
Fall 2008 Dardenne Creek Macroinvertebrate Composition

↓Variable Station→	1	2	3	4	4.1	5	6.1
Taxa Richness	70	71	63	65	59	67	80
Number EPT Taxa	10	15	10	13	13	11	15
% Ephemeroptera	39.2	40.4	32.8	47.6	50.8	38.0	31.2
% Plecoptera	0.0	0.0	0.0	0.2	<0.1	<0.1	<0.1
% Trichoptera	17.5	15.3	16.4	13.2	12.6	8.6	15.1
MSCI Score	12	12	14	12	12	12	16
% Dominant Families							
Chironomidae	27.8	25.2	30.6	24.1	24.4	30.5	32.2
Caenidae	20.8	21.3	17.2	21.0	23.3	23.5	15.6
Hydropsychidae	15.8	13.6	13.1	11.9	11.6	--	14.1
Baetidae	14.9	14.5	10.4	17.5	15.5	8.9	7.7
Elmidae	3.9	--	8.8	--	--	--	--
Simuliidae	--	6.4	--	--	--	8.5	--
Heptageniidae	--	--	--	8.9	11.9	--	7.7
Hyalellidae	--	--	--	--	--	8.3	--

Fall 2008 macroinvertebrate samples from Dardenne Creek averaged 68 total taxa (range 59-80) and 12 EPT Taxa (range 10-15) (Table 10). Of the top five dominant taxa, four were consistently present among Dardenne Creek stations, with the exception that the caddisfly family Hydropshychidae was barely eclipsed by amphipods (Hyalellidae) at

Station 5. At the remaining stations, two mayfly families (Caenidae and Baetidae) and one caddisfly family (Hydropshychidae), along with midges (Chironomidae), made up four of the top five dominant taxa. The highest abundance of mayflies occurred at Station 4.1, where they accounted for slightly more than half the sample. For the remaining stations, mayflies made up at least one-third of samples. Caddisflies were present in varying abundance among Dardenne Creek stations, but made up a slightly lower percentage of samples at Stations 4, 4.1, and 5. Stoneflies were absent from the downstream three stations, with no more than three individuals present at any of the upstream four stations.

Spring 2009 macroinvertebrate samples from Dardenne Creek averaged 74 total taxa (range 68-83) and 17 EPT Taxa (range 14-21) (Table 11). As was the case in fall samples, four taxonomic families were consistently in the top five dominant taxonomic families among Dardenne Creek stations. A fifth family, Heptageniidae, was one of the top five families at five of the seven stations. At each Dardenne Creek station, the top three dominant taxa groups were Chironomidae, Baetidae, and Caenidae. A stonefly family, Perlidae, was fourth in abundance at two stations and fifth at the remaining five stations. Mayflies were present in similar percentages among Dardenne Creek stations, with the exception that Station 5 was lower. Compared to fall samples, mayflies and caddisflies were present in much lower percentages. Midges were much more abundant in spring, making up at least two-thirds of all Dardenne Creek samples. Whereas almost no stoneflies were present in fall samples, they represented between two and five percent of spring samples.

Table 11
Spring 2009 Dardenne Creek Macroinvertebrate Composition

↓Variable	Station→	1	2	3	4	4.1	5	6.1
Taxa Richness		71	81	71	69	83	68	77
Number EPT Taxa		15	17	20	18	21	15	14
% Ephemeroptera		20.9	22.7	17.9	22.8	19.7	14.0	16.3
% Plecoptera		2.1	2.2	5.1	3.8	4.8	3.0	4.6
% Trichoptera		2.4	0.2	1.5	1.1	1.2	0.2	0.2
MSCI Score		14	16	16	16	20	14	16
% Dominant Families								
Chironomidae		68.0	69.0	66.9	67.7	65.1	75.9	68.5
Baetidae		11.1	11.8	11.7	14.7	13.3	6.5	7.2
Caenidae		8.5	9.1	3.2	4.5	4.2	5.0	4.1
Perlidae		1.8	1.3	3.0	2.5	2.3	2.0	3.2
Hydropsychidae		1.7	--	--	--	--	--	--
Heptageniidae		--	1.7	2.8	3.5	--	2.4	4.9
Simuliidae		--	--	--	--	2.4	--	--

7.2.3 Control Station Macroinvertebrate Community Composition

Fall 2008 macroinvertebrate samples from the control stations averaged 68 total taxa (range 50-78) and 11 EPT Taxa (range 9-15) (Table 7). Compared to Dardenne Creek, there was more variability in the macroinvertebrate families that made up the five dominant taxonomic families. Whereas four taxa accounted for the five most abundant families at all but one Dardenne Creek station, this consistency was not observed among the control stations. Chironomids were the dominant taxa at all but North Fork Cuivre River, where they were a close second in abundance. Although chironomids were the top taxa group at Hays Creek, mayflies in the family Caenidae had nearly the same abundance. Samples from control streams tended to contain a lower percentage of caddisflies than samples from Dardenne Creek. Only North Fork Cuivre River and Sugar Creek had caddisflies present in comparable abundance to most Dardenne Creek stations. Stoneflies also were rare among the control stations, being represented by only a few individuals at most stations and none in the North Fork Cuivre River sample. Black fly larvae (Simuliidae) were among the top five dominant taxa at all control stations except Hays Creek; black flies were less abundant in Dardenne Creek, where they were among the top five at only Stations 2 and 5.

Table 12
Fall 2008 Dardenne Creek Study Control Stream Macroinvertebrate Composition

↓Variable Station→	Big Ck. #1	Hays Ck. #1	NFCR #1	South R. #4	Sugar Ck. #1
Taxa Richness	76	67	50	78	67
Number EPT Taxa	15	9	9	12	10
% Ephemeroptera	29.8	41.3	41.7	19.0	23.8
% Plecoptera	0.4	0.2	0.0	<0.1	0.1
% Trichoptera	5.5	7.8	16.4	6.7	13.6
MSCI Score	16	12	12	16	14
% Dominant Families					
Chironomidae	46.9	32.8	26.6	39.2	28.3
Caenidae	17.6	31.9	29.3	--	--
Simuliidae	7.2	--	5.6	11.4	16.0
Heptageniidae	6.2	7.1	--	--	13.0
Baetidae	5.8	--	9.7	11.8	--
Hydropsychidae	--	7.8	16.2	--	13.4
Elmidae	--	4.1	--	6.6	--
Tubificidae	--	--	--	5.0	--
Asellidae	--	--	--	--	7.8

Spring 2009 macroinvertebrate samples from the control stations averaged 69 total taxa (range 61-77) and 14 EPT Taxa (range 12-20) (Table 13). As with the fall data, more variability existed among macroinvertebrate families that made up the five dominant taxa. Chironomids were the dominant taxa at each of the control stations, ranging from roughly half at Sugar and Hays creeks to about three-quarters at the remaining controls. Mayflies tended to be less abundant among the control sites compared to Dardenne Creek in spring, with only Hays Creek having a comparable percentage. Caenid mayflies were among the top five taxa at each control site except Sugar Creek (where mayflies made up only 1.3 percent of the sample). Although mayflies were relatively rare at Sugar Creek, this station had the highest percentage of stoneflies (11.3 percent) of any sample in the study. Sugar Creek also exhibited an abundance of crustaceans, with amphipods (Crangonyctidae) and aquatic sowbugs (Asellidae) combining to account for 37.5 percent of the sample. Hays Creek and South River also had crustaceans among the top five dominant taxa, but not in similar abundance compared to Sugar Creek. With the exception of Hays and Sugar creeks, stoneflies were present in lower percentages among the control sites than Dardenne Creek. Sugar Creek was the only control station to have a stonefly (Chloroperlidae) present among the top five dominant taxa. Caddisflies were present in roughly comparable percentages among control and Dardenne Creek sites.

Table 13
Spring 2009 Dardenne Creek Study Control Stream Macroinvertebrate Composition

↓Variable Station→	Big Ck. #1	Hays Ck. #1	NFCR #1	South R. #1	Sugar Ck. #1
Taxa Richness	69	68	61	77	68
Number EPT Taxa	14	13	12	13	20
% Ephemeroptera	10.6	17.0	11.9	4.8	1.3
% Plecoptera	1.9	4.0	0.9	0.4	11.3
% Trichoptera	1.9	1.2	4.4	1.4	0.8
MSCI Score	12	14	14	14	16
% Dominant Families					
Chironomidae	73.5	57.5	73.4	77.4	41.8
Caenidae	5.5	14.1	6.5	2.8	--
Elmidae	4.1	--	3.4	3.1	--
Heptageniidae	3.3	2.9	--	--	--
Simuliidae	2.6	4.1	--	--	4.9
Crangonyctidae	--	12.7	--	--	19.4
Hydropsychidae	--	--	4.3	1.4	--
Baetidae	--	--	4.0	--	--
Gammaridae	--	--	--	6.1	--
Chloroperlidae	--	--	--	--	5.4
Asellidae	--	--	--	--	18.1

7.3 Benthic Sedimentation Analysis

Percentage of benthic fine sediment coverage was measured at each of seven Dardenne Creek test stations. In addition, sediment was measured at control stations on Big Creek, Hays Creek, North Fork Cuivre River, Sugar Creek, and four stations on South River. Benthic sediment measurements using the visual estimation method for each station are presented in Table 14, whereas measurements using the USFS pebble count frame method are presented in Table 15. These data also are displayed graphically in Figure 3 (Dardenne Creek) and Figure 4 (control stations). For comparison, mean percent fine sediment observed in 2002 (Campbell 2002) are included in Figure 3.

Sediment data were pooled and segregated in numerous combinations and were analyzed separately by method (Table 16). For example, pooled test station data were compared with pooled control station data for an overview; the data also were segregated by sample station and compared individually with control station data. The two methods of sediment measurement also were compared to determine the extent to which they were in statistical agreement. Statistical analyses are presented as SigmaStat® printouts in Appendix D for each data set.

Although Dardenne Creek Station 1 had higher fine benthic sediment coverage than the remaining upstream stations, no longitudinal pattern of sediment distribution was evident. Dardenne Creek stations 1, 2, 3, 4, and 6.1 had comparable percent coverage, whereas stations 4.1 and 5 were considerably lower. Visual sediment estimates followed a pattern similar to that observed in Campbell's 2002 study. Among control streams, the three downstream South River stations had higher fine sediment percentages than the remaining control stations.

Dardenne Creek test stations tended to have a higher percentage of benthic fine sediment than the control streams. When pooling all Dardenne Creek sediment data to compare with pooled control station data, Dardenne Creek sediment coverage was significantly higher than the suite of control stations, regardless of the measurement method used ($p<0.001$ for both methods). Using the visual estimation method, Dardenne Creek stations averaged 58.3 percent (range 16.9-85.7 percent), whereas with the pebble count frame method, Dardenne Creek stations averaged 54.8 percent (range 13.6-86.8 percent).

The two sediment measurement methods resulted in identical results for each station in terms of statistical significance, with a single exception. This exception was at Dardenne Creek Station 5, where the pebble count frame provided a slightly lower sediment measurement than the visual estimation method (13.6 percent versus 16.9 percent for the visual). This small difference between the two methods was sufficient to yield a significant difference for the pebble count frame method when comparing Dardenne Creek Station 5 to the pooled suite of control data ($p=0.028$), but not for the visual estimation method ($p=0.069$). In this particular instance, the pebble count frame method indicated that Dardenne Creek Station 5 fine sediment was significantly lower than the control data set.

Table 14
Percentage of Benthic Sediment Observed per Grid and Quadrat Using Visual Estimation Method at Dardenne Creek and Control Stream Sample Stations, Fall 2008

Grid No.-Quadrat No.	Dardenne Creek							Big Ck.	Hays Ck.	NFCR	Sugar Ck.	South River			
	1	2	3	4	4.1	5	6.1	1	1	1	1	1	2	3	4
1-1	100	77.5	99	98	5	0	75	0	100	3.5	0	5	100	65	0
1-2	100	52.5	100	100	0	5	85	0	100	47.5	5	2	77.5	100	22.5
1-3	100	7.5	80	87.5	5	10	72.5	0	15	10	0	4	87.5	100	2.5
1-4	10	5	100	40	5	17.5	80	0	0	0	0	2.5	17.5	62.5	0
1-5	27.5	90	100	100	0	0	70	0	100	15	0	0	65	100	10
1-6	92.5	27.5	100	15	10	5	7.5	10	100	17.5	0	15	60	100	80
2-1	100	99	100	7.5	100	0	98	0	17.5	0	7.5	72.5	77.5	65	17.5
2-2	100	100	0	42.5	100	0	40	72.5	45	100	100	100	82.5	75	0
2-3	92.5	100	100	10	3.5	0	82.5	0	22.5	0	3.5	100	72.5	55	0
2-4	100	42.5	100	22.5	100	4	100	75	0	100	5	85	42.5	7.5	17.5
2-5	100	5	100	12.5	0	0	15	60	0	70	2.5	100	47.5	100	0
2-6	87.5	95	22.5	5	100	0	100	22.5	5	0	37.5	82.5	50	37.5	0
3-1	100	100	5	100	17.5	5	85	22.5	10	0	15	95	32.5	40	7.5
3-2	100	12.5	65	100	0	32.5	75	40	0	5	0	96.5	15	5	50
3-3	100	100	0	100	0	100	100	0	0	0	0.5	95	100	30	0
3-4	32.5	100	85	100	25	5	100	0	0	70	1	100	100	100	45
3-5	100	5	87.5	100	12.5	100	92.5	0	45	0	5	92.5	100	100	17.5
3-6	100	100	37.5	100	100	20	90	0	5	100	0	100	100	5	0
Mean	85.7	62.2	71.2	63.4	32.4	16.9	76.0	16.8	31.4	29.9	10.1	63.8	68.2	63.8	15

Table 15
Percentage of Benthic Sediment Observed per Grid and Quadrat Using USFS Pebble Count Frame Method at Dardenne Creek and Control Stream Sample Stations, Fall 2008

Grid No.-Quadrat No.	Dardenne Creek							Big Ck.	Hays Ck.	NFCR	Sugar Ck.	South River			
	1	2	3	4	4.1	5	6.1	1	1	1	1	1	2	3	4
1-1	12	4	72	100	0	0	16	0	100	25	0	8	20	24	12
1-2	100	4	100	32	0	4	0	0	92	8	32	4	8	0	0
1-3	98	0	88	100	0	0	8	0	76	0	0	12	8	8	16
1-4	100	8	100	100	0	0	0	0	40	4	0	0	16	0	8
1-5	84	12	100	100	0	0	40	0	4	32	0	0	0	100	28
1-6	100	4	28	96	0	0	80	0	24	4	0	24	32	36	0
2-1	92	0	100	0	100	0	96	0	12	60	8	100	92	92	0
2-2	100	100	100	56	100	0	72	28	8	32	0	28	0	100	0
2-3	100	100	100	0	100	0	52	0	0	52	0	40	48	68	4
2-4	100	44	100	76	20	0	36	28	52	44	0	20	96	36	0
2-5	100	92	92	100	0	0	44	0	16	40	36	100	8	56	0
2-6	100	52	100	100	60	8	64	20	60	68	0	28	84	0	0
3-1	100	100	0	100	4	0	12	4	0	40	4	64	60	0	0
3-2	60	100	60	100	12	48	32	12	0	56	0	100	100	4	0
3-3	100	100	0	100	12	100	100	4	0	0	0	24	100	16	0
3-4	16	88	32	100	8	0	100	0	0	60	0	0	100	20	8
3-5	100	80	28	100	100	4	100	0	4	40	8	56	100	96	0
3-6	100	100	0	100	48	80	40	0	0	72	0	76	100	0	0
Mean	86.8	54.9	66.7	81.1	31.3	13.6	49.6	5.3	27.1	35.4	4.9	38.0	54	36.4	4.2

Table 16
Dardenne Creek Sediment Estimation Statistical Comparisons

Data comparison (mean in parentheses)	Measurement method	p-value	Statistically Significant
All Dardenne (58.2) vs. All Controls (37.4)	Visual	$p<0.001$	yes
All Dardenne (54.8) vs. All Controls (25.2)	Frame	$p<0.001$	yes
DC #1 (85.7) vs. All Controls (37.4)	Visual	$p<0.001$	yes
DC #1 (86.8) vs. All Controls (25.2)	Frame	$p<0.001$	yes
DC #2 (62.2) vs. All Controls (37.4)	Visual	$p=0.007$	yes
DC #2 (54.9) vs. All Controls (25.2)	Frame	$p=0.004$	yes
DC #3 (71.2) vs. All Controls (37.4)	Visual	$p=0.002$	yes
DC #3 (66.7) vs. All Controls (25.2)	Frame	$p<0.001$	yes
DC #4 (63.4) vs. All Controls (37.4)	Visual	$p=0.003$	yes
DC #4 (81.1) vs. All Controls (25.2)	Frame	$p<0.001$	yes
DC #4.1 (32.4) vs. All Controls (37.4)	Visual	$p=0.789$	no
DC #4.1 (31.3) vs. All Controls (25.2)	Frame	$p=0.771$	no
DC #5 (16.9) vs. All Controls (37.4)	Visual	$p=0.069$	no
DC #5 (13.6) vs. All Controls (25.2)	Frame	$p=0.028$	yes
DC #6.1 (76.0) vs. All Controls (37.4)	Visual	$p<0.001$	yes
DC #6.1 (49.6) vs. All Controls (25.2)	Frame	$p=0.003$	yes
All Visual (38.75) vs. All Pebble Ct Frame (24.00)	N/A	$p=0.017$	yes
DC Visual (58.2) vs. DC Pebble Ct Frame (54.8)	N/A	$p=0.437$	no
Control Vis (37.4) vs. Control Pebble Ct Frame (25.7)	N/A	$p=0.016$	yes

Figure 3
Dardenne Creek Benthic Sediment Coverage

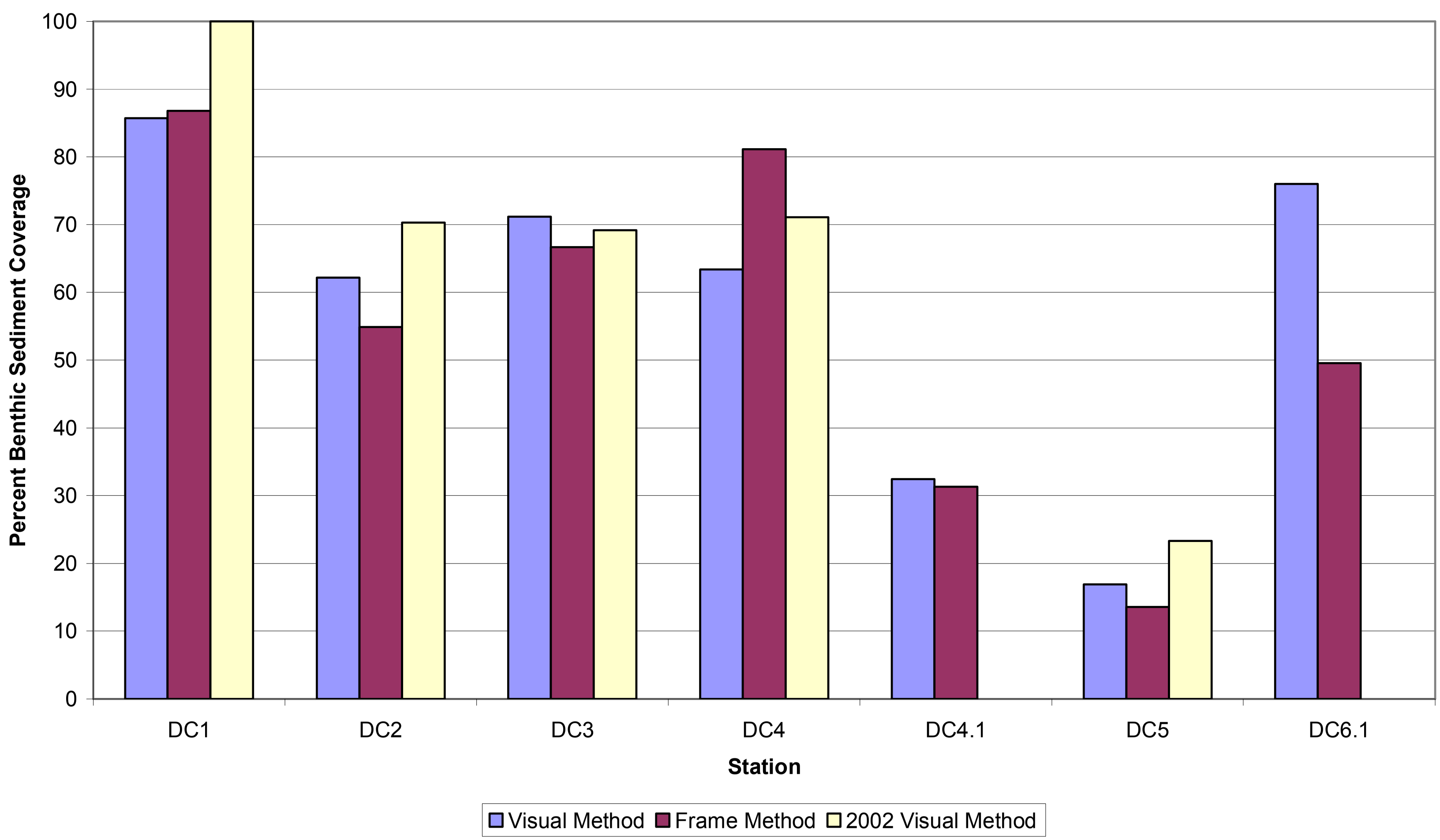
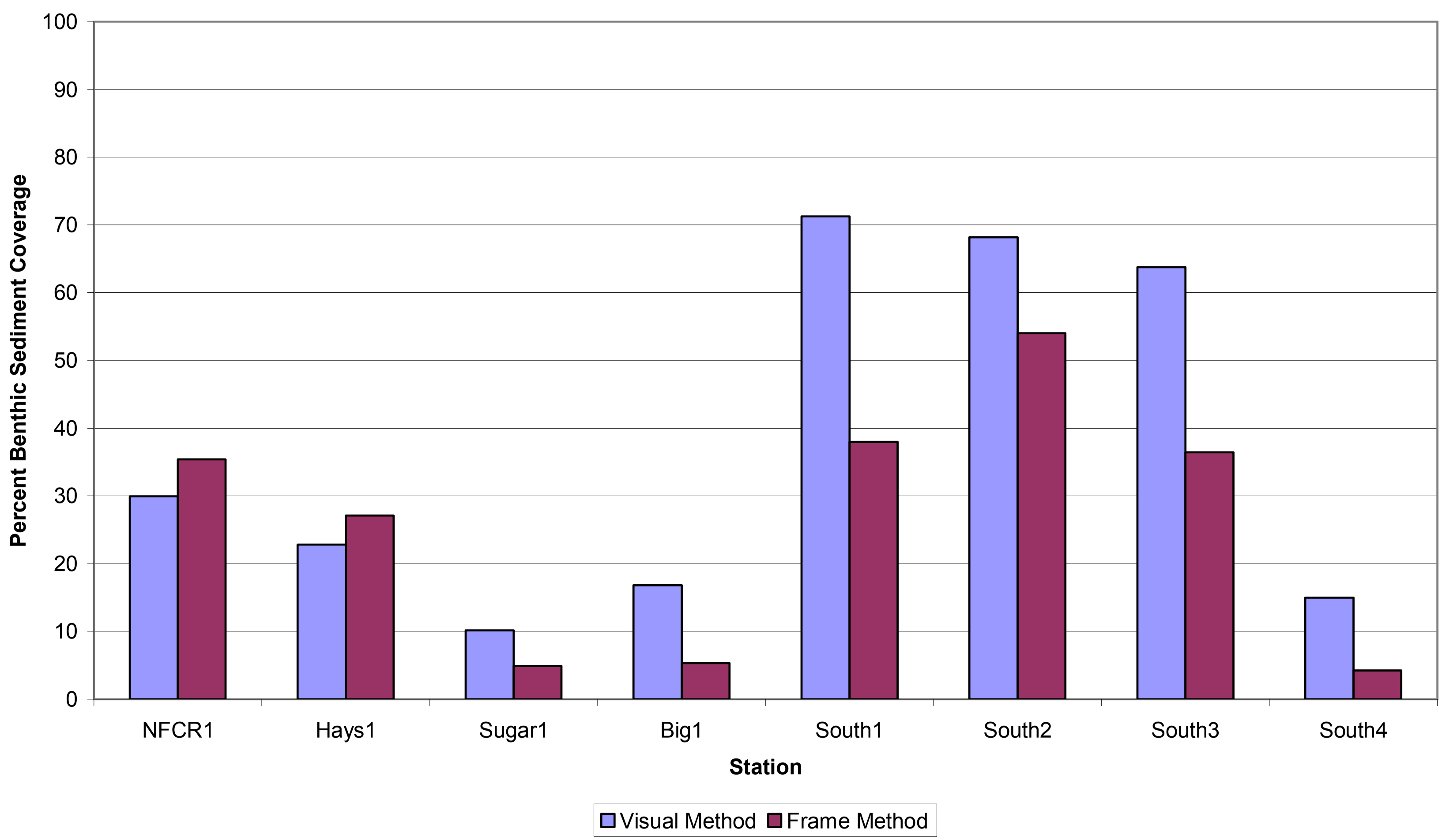


Figure 4
Control Station Benthic Sediment Coverage



When comparing the two methods using all data from this study, the visual estimation method tended to yield higher percentages of fine benthic sediment than the pebble count frame ($p=0.017$). This difference was more pronounced among the control stations, where the mean pebble count frame estimate (mean=25.7 percent) was lower than the visual estimation method (mean=37.4 percent) ($p=0.016$). Among Dardenne Creek stations, however, the two methods were much more in agreement to the extent that there was no significant difference ($p=0.437$) between the visual (mean=58.2) and the pebble count frame method (mean=54.8).

8.0 Discussion

8.1 Water Quality

Fall water quality parameters were generally similar among Dardenne Creek stations, with few remarkable features. Nutrient concentrations were relatively low at the time samples were collected and were longitudinally consistent, with Station 1 having only slightly higher nitrite+nitrate-nitrogen and total nitrogen than the remaining Dardenne Creek stations in fall 2008. The large decrease in flow upstream of Station 3 was surprising, given that Stations 3 and 4 are quite close to one another and there are no major tributaries between them. Based on USGS gage #05514840 at O'Fallon (downstream of the study reach), the mean flows for September 24 and September 23 were identical, but 6 cfs lower on September 25. Flow was measured at Station 4 on the morning of September 24, whereas Station 3 was sampled the previous afternoon. It appears that samples were collected at a time when Dardenne Creek discharge was trending downward after a significant spike earlier in the month (the remnants of Hurricane Ike resulted in a peak discharge of over 8,000 cfs on September 14, 2008). Because these stations are located approximately seven miles upstream of the O'Fallon gage, the diminished flow likely would have occurred in the study reach before being recorded at the gage.

Nutrient concentrations were higher at North Fork Cuivre River, South River, and Sugar Creek than the remaining control stations or any of the Dardenne Creek stations in fall. South River, a biological criteria reference site, had the highest concentrations of nitrite+nitrate-nitrogen, total nitrogen, and chloride of any station in this study. Although the watershed surrounding the river reach is largely agricultural, the amount of row crop and pastureland in the South River watershed is comparable to several of the other control stations. No obvious source of these nutrients was observed at the time samples were collected.

Spring water quality parameters also were similar among Dardenne Creek stations. Nutrient values in spring were similar to or lower than fall, but chloride concentrations tended to be higher for all stations in spring. Although chloride concentrations were higher among spring Dardenne Creek samples, they were lower than each of the control stations except Hays Creek. Discharge among stations located downstream of Little Dardenne Creek--Stations 1-4--was approximately three times higher than Station 4.1, which was located just upstream of the confluence. Station 3 had slightly lower flow than either station up- or downstream of it, suggesting that some channel anomaly or subsurface flow may have affected our discharge measurement at this site.

As would be expected, nutrient concentrations were more variable among the control stations than the Dardenne Creek stations. Although selected control stations were as similar to the test stream as possible, they were more widely distributed spatially which likely led to at least some variability in individual watershed land use, soil type, and geologic conditions compared to the within-system distribution of the Dardenne Creek sites. Ammonia as nitrogen was below detectable levels at all stations but as with fall, nitrite+nitrate-nitrogen, total nitrogen, and chloride all were highest at South River. Chloride concentrations were at least somewhat higher than Dardenne Creek at each of the control stations except Hays Creek. Chloride at North Fork Cuivre River was roughly comparable to Dardenne Creek, with Big Creek, South River, and Sugar Creek all having higher concentrations.

8.2 Biological Assessment

8.2.1 Dardenne Creek Longitudinal Assessment

With the exception of Station 6.1, no Dardenne Creek sample stations achieved a fully supporting MSCI score in fall. Whereas the study conducted by Campbell in 2002 noted a general increasing trend among biological metrics in downstream stations, no such trend was observed in fall 2008. For fall 2008 samples, the highest biological metric and MSCI scores occurred at Station 6.1, the uppermost station. Only Station 6.1 had a sufficient number of taxa for the Taxa Richness metric to reach the maximum score of 5. None of the Dardenne Creek sites, including Station 6.1, had the required number of EPT Taxa to achieve a score of 5.

Control station MSCI scores were similar to those of Dardenne Creek. Of the five control stations, only two (Big Creek and South River) achieved fully supporting MSCI scores. Similar to Dardenne Creek Station 6.1, only Taxa Richness and Shannon Diversity Index reached a maximum individual biological metric score of 5 at Big Creek and South River. None of the control stations had sufficient numbers of EPT Taxa to score more than 3 for this metric.

Compared to the two previous studies conducted on this reach of Dardenne Creek (Campbell 2002, Michaelson 2007), flow during the months preceding the fall 2008 sample season were not exceedingly low and should not have been a factor negatively affecting the macroinvertebrate community. However, less than two weeks before samples were collected in September 2008, the remnants of Hurricane Ike took a northeasterly path through much of Missouri. This path included the Dardenne Creek watershed and each of the control station watersheds, resulting in heavy rains and widespread flooding. As mentioned in Section 8.1, the USGS gage at O’Fallon recorded a peak discharge of over 8,000 cfs approximately 10 days before macroinvertebrate and water quality samples were collected. Given the seemingly ideal conditions for macroinvertebrate production during the mild summer months of 2008, it is likely that at least some of the poor metric performance and MSCI scores could be attributable to high flow scour and resultant macroinvertebrate drift. Although this effect was not universal, with three stations achieving fully supporting status, none of the 12 samples had an MSCI score higher than 16. With the combination of seasonal conditions prior to sampling and the number of control stations, one of which was a biological criteria reference station, it would normally be expected that at least some would have had MSCI scores of 18 or 20.

Spring 2009 Dardenne Creek samples overall had higher MSCI scores than any previous sample season (Table 17) and also were higher than or equal to each of the spring control stations. Weather conditions during the months preceding spring sampling seemed more favorable for macroinvertebrate production than what was experienced during previous Dardenne Creek studies. Both the 2002 and 2005 studies were conducted during drought conditions, and each study's final report recommended that samples be collected during years in which rainfall approximates a "normal" year. Spring 2009 was the first of six sample events in this reach of Dardenne Creek that was influenced by neither drought nor

Table 17
Dardenne Creek Macroinvertebrate Stream Condition Index Scores

Station	Spring 02	Fall 02	Fall 05	Spring 06	Fall 08	Spring 09
1	14	16	--	--	12	14
2	14	16	--	--	12	16
3	8	16	14	14	14	16
4	8	10	10	12	12	16
4.1	--	--	10	12	12	20
5	12	12	--	--	12	14
6	8	12	--	--	--	--
6.1	--	--	--	--	16	16

flood. Therefore, it would typically be inferred that these metric scores are representative of an ideal Dardenne Creek macroinvertebrate community. The relatively poor performance of the control stations, however, casts some doubt on this assumption. As Dardenne Creek biological metrics and MSCI scores increased, so too should the controls. Although biological criteria reference streams occasionally fail to achieve fully supporting scores, (for example, of eight total South River samples, two had MSCI scores of 14) test streams and control streams should respond similarly, barring some disturbance specific to one of the drainages. If a single control stream had performed poorly in spring samples, it could have been attributed to some acute event that had occurred between the two sample seasons. In the case of this study, however, nearly all of the control streams (including the biological reference) achieved only partially supporting status. Given the similarity of weather and rainfall patterns in this portion of the state during the months prior to sampling, there does not appear to be a readily apparent explanation for these scores.

8.2.2 Dardenne Creek Macroinvertebrate Community Composition

Of the top five dominant taxonomic families, four were common among all but one Dardenne Creek station in fall samples. In addition to chironomids, the other three were families within the grouping of EPT Taxa--Caenidae, Hydropsychidae, and Baetidae. Despite the relative abundance of these mayfly and caddisfly families, diversity was somewhat lacking and resulted in the moderately low fall EPT Taxa scores discussed in the previous section. Although chironomids were the dominant taxa group at each of the Dardenne Creek stations, they did not contribute an overwhelming majority at most stations. Except for Stations 3 and 6.1, chironomid and caenid mayflies were nearly equal in abundance. Stoneflies were nearly absent among Dardenne Creek stations, which is a common occurrence in fall samples.

With respect to the top five dominant families, a trend similar to the fall samples was observed in spring. That is, four families were common among all Dardenne Creek stations in spring samples. Chironomids were dominant at all stations and the remaining families all were EPT Taxa-- the mayflies Baetidae and Caenidae and the stonefly Perlidae. A third mayfly family, Heptageniidae, was among the five dominant families at five of the seven Dardenne Creek stations. When considering the dominant taxa among Dardenne Creek stations as a whole, all but two taxa groups--Chironomidae and Simuliidae--were within the EPT Taxa group. As was the case with fall, less diversity existed among four of the top five dominant taxa compared to the control stations in spring samples.

8.2.3 Control Station Macroinvertebrate Community Composition

Unlike Dardenne Creek, in which four of five dominant families at all stations were nearly the same, more diversity was observed among the dominant families for fall control samples. Because of differences in spatial and size distribution from which the control samples were collected, compared to Dardenne Creek, more diversity would be expected. Overall, however, a similar number of taxa contributed to the top five dominant families. Whereas eight families were included among the top five among Dardenne Creek stations, nine families were present in the top five for the control stations. Chironomids were the dominant majority at three of the five control stations, unlike Dardenne Creek, where chironomids and caenid mayflies tended to be present in comparable numbers at most sites. Caenid mayflies were not consistently abundant among the control stations and were not within the top five dominant taxa at South River and Sugar Creek. At North Fork Cuivre River and Hays Creek, however, caenids were roughly equal in abundance with chironomids and were actually the dominant family at the North Fork Cuivre River station. Caddisflies were present in lower percentages than Dardenne Creek at all control stations except North Fork Cuivre River and Sugar Creek. As was the case with Dardenne Creek, only one caddisfly family, Hydropsychidae, was among the control station dominant taxa.

As with fall samples, spring samples for control streams exhibited more diversity among the dominant taxa than Dardenne Creek. Whereas seven families were present among the dominant families in Dardenne Creek samples (with Hydropsychidae and Simuliidae being dominant only at a single station each), 11 families made up the dominant families list for the controls. Of those 11, however, four were dominant only at a single station. Only Chironomidae was common to all five control streams as a dominant taxa group. Caenid mayflies were among the dominant taxa at all but the Sugar Creek sample which, aside from chironomids, was mostly made up of the crustaceans Crangonyctidae and Asellidae. Fewer EPT Taxa were present among the five dominant taxa among the control stations than Dardenne Creek. In addition, of the four EPT Taxa that were among the dominant taxa, two families were present at only a single site.

8.3 Benthic Sedimentation Analysis

Although sediment data were analyzed in numerous combinations, the main focus of this portion of the study was to answer the fundamental question of whether Dardenne Creek has a greater benthic fine sediment component than other comparable streams within the Central Plains/Cuivre/Salt EDU. This issue was addressed in Campbell's 2002 biological assessment report, but the visual sediment estimation method used was considered by some to be subjective. Interestingly, however, the visual method used in 2008 yielded similar results compared to the 2002 study, despite the years separating the studies and the inclusion of a different investigator (Figure 3). To address any possible subjectivity of the visual estimation method, a strictly quantitative method using the pebble count frame was used in tandem with the visual estimation method. The two methods were then compared to determine the degree to which any error using the visual estimation method may skew the results of a benthic fine sediment survey.

A factor that was considered when conducting this sediment survey investigation was the effect that hurricane-related high flows may have had on instream fine sediments. Although these flows were almost certainly above the threshold to be considered "channel forming events," it was decided that because flooding occurred throughout the entire study area, including the control streams, conditions among test and control stations would have been equally affected.

The results of this study indicate that the Dardenne Creek survey reach, from the August A. Busch Conservation Area to the Foristell Road bridge crossing in St. Charles County, has a higher percentage of benthic fine sediment (<2 mm in size) than control streams within the same EDU at a statistically significant level ($p<0.001$). This conclusion was reached using both the visual and the pebble count frame methods.

With respect to statistical significance, the two methods were in agreement for every comparison presented with the exception of one. In this single case, which occurred at Dardenne Creek Station 5, the disparity resulted in the visual estimation method concluding that there was no difference between Station 5 versus the pooled control data set, whereas the pebble count frame method concluded that Station 5 was significantly *lower* than the controls. For the remaining comparisons between data sets--Dardenne Creek test stations versus control stations--the two methods gave the same results.

In comparing the two methods with each other using all available data from this study, the visual estimation method tended to give a higher percent coverage of fine sediment than the pebble count frame method. This tendency was more pronounced in areas where fine sediment was less prevalent. Percent coverage measurements between the two methods were more consistent with one another among Dardenne Creek stations ($p=0.437$) where the percentage of fine sediment was higher, but when comparing the methods using only the control station data, the estimates differed by a significant margin ($p=0.016$). Investigators using the pebble count frame method only included fine sediment that was located directly under the 25 intersections of subdividing bands. As a result, the majority of surface area within the confines of the quadrat is not used for sediment measurement. In areas where sediment is more abundant and widespread, this bias was not as apparent compared to sample locations in which only a small percentage of the area within the quadrat is covered in fine sediment. In locations with minimal or patchy sediment coverage, the odds of an individual intersection point occurring directly over a patch of fine sediment appears to be lower than if the quadrat were on a streambed dominated by fine sediment.

Some of the difference observed between methods may be due to the distribution of random numbers selected within transects. The original intent, as described in the study plan (Appendix C) was to select one set of random numbers and use the same locations for both methods. Because of its larger size (60 cm per side versus 25 cm per side), however, the pebble count frame locations overlapped when random numbers required the placement of visual quadrats in close proximity; as a result, a separate set of random numbers was used for each method. Separate random number sets resulted in some variability within the stream where sediment was measured. Because of the stratified random sampling design used (a requirement for statistical analysis to be valid), this type of sample location distribution is unavoidable. When the entire data set was considered, however, the overall conclusions were unaffected.

9.0 Null Hypotheses

1. The macroinvertebrate community will not differ longitudinally among Dardenne Creek study sites. This hypothesis is accepted. With the exception of the uppermost sample station, MSCI scores and scores of the biological metrics were largely similar among fall Dardenne Creek samples, regardless of their position in the watershed. Although differences in MSCI scores existed during both sample seasons, there was not a longitudinal trend.

2. The Dardenne Creek macroinvertebrate community will not differ from that of reference streams within the Central Plains/Cuivre/Salt Ecological Drainage Unit. This hypothesis is rejected. Reference streams within the EDU represent the best available conditions and are what the MSCI scores are based on. Because all but one Dardenne

Creek station failed to achieve fully supporting status in fall 2008, the Dardenne Creek macroinvertebrate community cannot be viewed as similar to reference streams within this EDU. In spring 2009, five of the seven Dardenne Creek stations had fully supporting MSCI scores. Of those five fully-supporting scores, however, four had MSCI scores of 16. When taking both seasons into consideration, Dardenne Creek would not be presumed to have a reference-quality macroinvertebrate community.

3. The Dardenne Creek macroinvertebrate community will not differ from that of local control streams. This hypothesis is accepted for the fall 2008 season. Of the five local control streams that were used in this study, two had fully supporting MSCI scores of 16; the remaining control streams achieved partially supporting status. For the spring 2009 season, the hypothesis is rejected. Biological metric scores and MSCI scores among Dardenne Creek stations tended to be higher than the suite of controls.

4. Water quality and nutrient parameters will not differ longitudinally among Dardenne Creek study sites. This hypothesis is accepted. No notable differences were observed among the Dardenne Creek stations, with the exception that flow in the upstream reach was reduced, likely due to decreasing flow occurring during the fall 2008 sample trip.

5. Dardenne Creek benthic sediment deposits will not be statistically different than biological reference or local control streams. This null hypothesis is rejected, regardless of the method used. Although there was variation among individual Dardenne Creek and control stream stations, the overall result was that Dardenne Creek tended to have a higher percentage of fine benthic sediment compared to control streams within the Central Plains/Cuivre/Salt EDU.

10.0 Conclusion

Including this study, Dardenne Creek has been the subject of three biological assessments between spring 2002 and spring 2009. A total of 32 macroinvertebrate samples have been collected and analyzed during this time, the majority of which have had MSCI scores toward the middle and upper range of partially biologically supporting. Because of the variability that has occurred during the relatively intensive sampling of this stream reach, it is difficult to arrive at any specific conclusion regarding the overall macroinvertebrate community. It appears that this reach of Dardenne Creek is subject to extremes in flow which may affect the macroinvertebrate community, based on biological metrics and MSCI scores. Considered collectively, the three biological assessments indicate that this Dardenne Creek study reach is a moderately impaired system, capable of occasionally sustaining macroinvertebrate communities that are comparable to or better than reference streams within the Central Plains/Cuivre/Salt EDU. However, the more typical case has been a macroinvertebrate community that is neither exceedingly good nor poor, compared to the reference condition.

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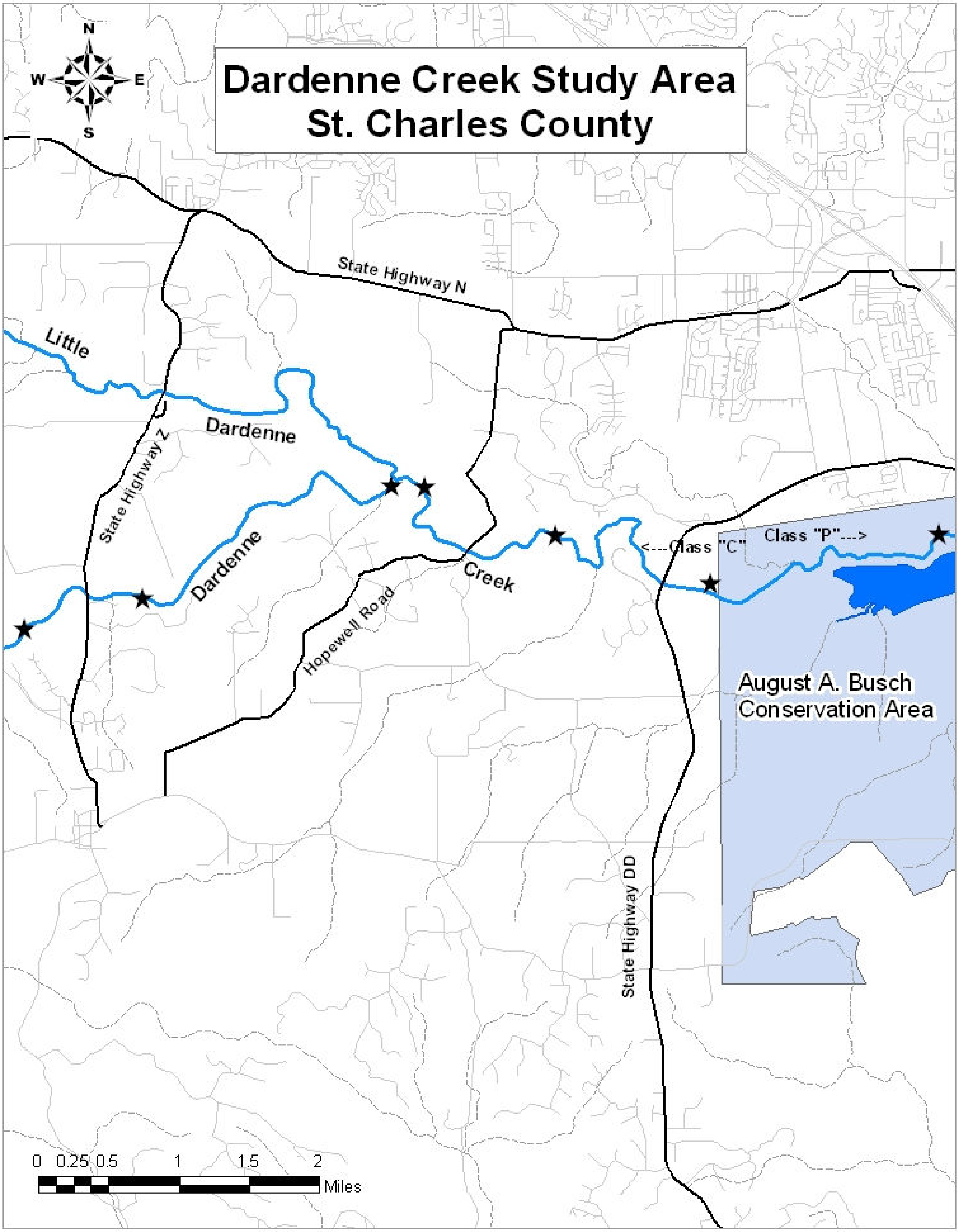
Appendix A

Maps

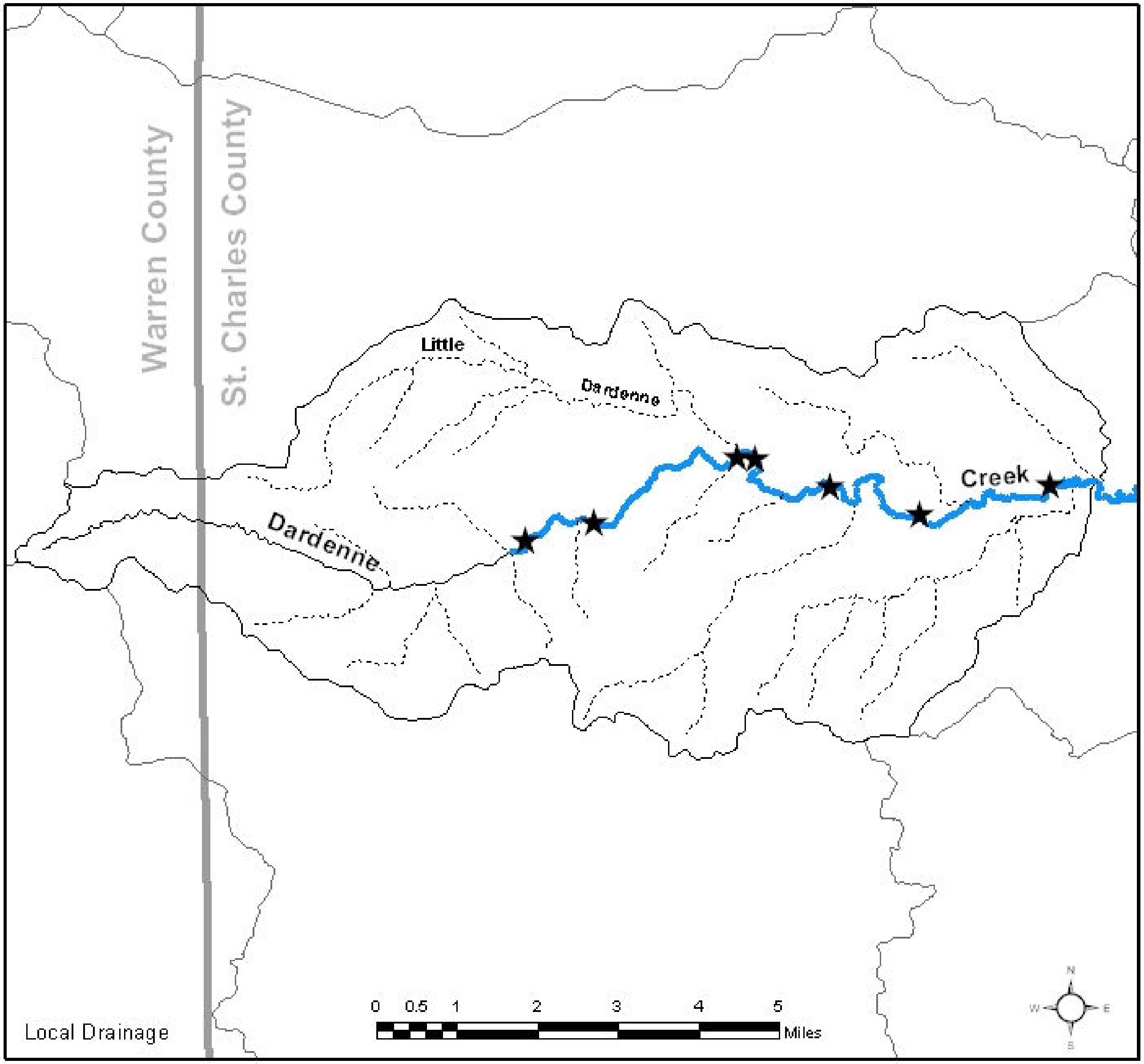
Sample Stations Located on Dardenne Creek
Central Plains/Cuivre/Salt EDU

Dardenne Creek Study Area
Central Plains/Cuivre/Salt EDU

Dardenne Creek Control Sites
Central Plains/Cuivre/Salt EDU


N
W
E
S
Dardenne Creek Study Area
St. Charles County
State Highway N
Little
Dardenne
State Highway Z
Dardenne
Creek
Hopewell Road
<---Class "C"
Class "P"--->
August A. Busch
Conservation Area
State Highway DD
0 0.25 0.5 1 1.5 2
Miles

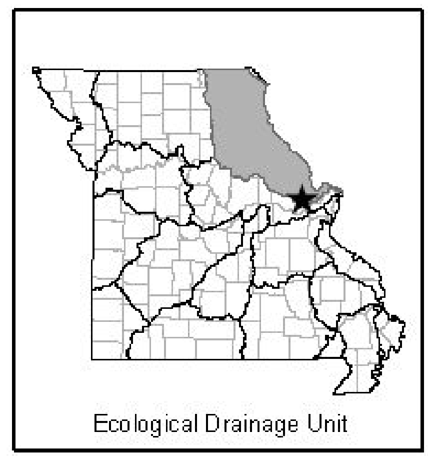
Dardenne Creek Study Area

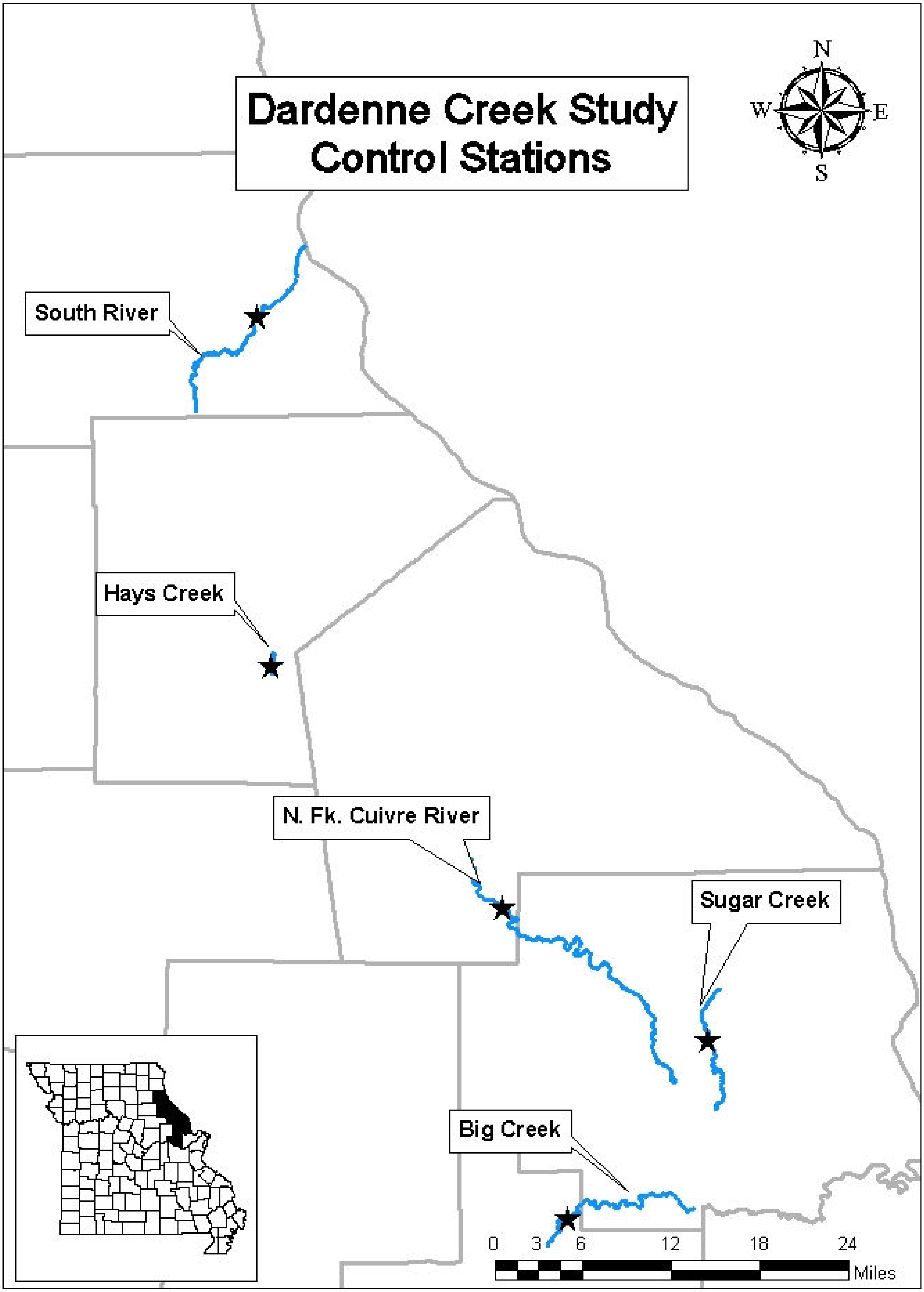


Local Drainage and Ecological Drainage Unit (EDU)

An EDU is an area that contains a unique combination of habitats and organisms. Missouri is divided into 19 EDUs as shown in the inset map below. This site is located in the highlighted EDU.

Local Drainage - The local drainage area, also known as a 14 Digit Hydrologic Unit, is shown in the main map at left. This area is a portion of the local watershed. Missouri is split into over 1500 such units.




Dardenne Creek Study
Control Stations
N
W
E
S
South River
Hays Creek
N. Fk. Cuivre River
Sugar Creek
Big Creek
0
3
6
12
18
24
Miles

Appendix B

Macroinvertebrate Taxa Lists

Dardenne Creek

Big Creek

Hays Creek

North Fork Cuivre River

South River

Sugar Creek

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804056], Station #1, Sample Date: 9/23/2008 12:15:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	4	2	
AMPHIPODA			
Gammarus	2	1	1
Hyalella azteca			5
COLEOPTERA			
Ancyronyx variegatus			1
Dubiraphia	1	2	9
Macronychus glabratus			1
Paracymus			2
Scirtidae		1	1
Stenelmis	34	4	
DECAPODA			
Orconectes virilis	-99		-99
DIPTERA			
Ablabesmyia		13	2
Anopheles		1	
Ceratopogoninae	1		
Cladotanytarsus	6	46	
Corynoneura		4	1
Cricotopus bicinctus	2	1	
Cricotopus/Orthocladius	8		
Cryptochironomus	1	6	
Demicryptochironomus	1		
Dicrotendipes	1	1	
Glyptotendipes		1	
Hexatoma	3		
Labrundinia			1
Microtendipes	1		
Nanocladius			2
Nilotanypus			1
Paracladopelma		5	
Paratanytarsus	1	4	13
Phaenopsectra		1	
Polypedilum convictum	74		1
Polypedilum halterale grp		5	
Polypedilum illinoense grp	7	6	2
Polypedilum scalaenum grp		3	
Rheotanytarsus	29	2	3
Saetheria	1	1	

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804056], Station #1, Sample Date: 9/23/2008 12:15:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Simulium	46		
Stempellinella		2	
Stictochironomus		6	
Tabanus	1		-99
Tanytarsus	8	56	27
Thienemanniella	1		
Thienemannimyia grp.	4		1
Zavrelimyia			1
EPHEMEROPTERA			
Acerpenna	90	9	1
Baetis	75		
Caenis latipennis	5	68	199
Procloeon		19	1
Stenacron		2	3
Stenonema femoratum	12	21	6
ISOPODA			
Caecidotea	1		
LIMNOPHILA			
Menetus			1
LUMBRICINA			
Lumbricina	1		-99
LUMBRICULIDA			
Lumbriculidae	1		
ODONATA			
Argia			5
Basiaeschna janata			-99
Boyeria			-99
Calopteryx			1
Enallagma			6
Progomphus obscurus		1	
Somatochlora			-99
TRICHOPTERA			
Cheumatopsyche	202		5
Chimarra	16		1
Oecetis	1		
Triaenodes			4
TRICLADIDA			
Planariidae			1
TUBIFICIDA			
Branchiura sowerbyi		2	

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804056], Station #1, Sample Date: 9/23/2008 12:15:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Enchytraeidae		1	
Tubificidae	26	24	
VENEROIDEA			
Corbicula	-99		-99
Sphaeriidae	5		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804057], Station #2, Sample Date: 9/23/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	4	3	
AMPHIPODA			
Crangonyx	1	1	
Gammarus			1
Hyalella azteca	3	1	41
COLEOPTERA			
Berosus			-99
Dubiraphia		2	5
Dytiscidae			1
Stenelmis	20	5	1
DECAPODA			
Orconectes virilis			-99
DIPTERA			
Ablabesmyia		9	6
Ceratopogoninae		1	
Chaoborus		1	
Chironomidae	1	3	
Chironomus		1	
Cladotanytarsus	14	32	
Corynoneura	1		1
Cricotopus bicinctus	1		
Cricotopus/Orthocladius	6		1
Demicryptochironomus	1		
Dicrotendipes		6	
Dolichopodidae	1		
Glyptotendipes		1	
Hemerodromia	3		
Hexatoma	7		
Labrundinia		2	1
Microtendipes		2	1
Nanocladius			1
Nilotanypus	1		
Paracladopelma		4	
Parametriocnemus	1		
Paratanytarsus	1	3	9
Paratendipes		1	
Polypedilum aviceps	1		
Polypedilum convictum	74		
Polypedilum illinoense grp	10	5	

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804057], Station #2, Sample Date: 9/23/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum scalaenum grp	3	1	
Rheotanytarsus	17	1	3
Saetheria	1	3	
Simulium	82		
Stictochironomus		6	
Tanytarsus	9	38	19
Thienemanniella	9		
Thienemannimyia grp.	6	1	2
EPHEMEROPTERA			
Acentrella	1		
Acerpenna	85		8
Baetis	79		
Caenis latipennis	18	85	168
Centroptilum		6	
Leptophlebiidae		1	
Procloeon		5	
Stenacron			1
Stenonema femoratum	31	21	3
ISOPODA			
Caecidotea (Blind & Unpigmented)		3	
LIMNOPHILA			
Menetus			1
Physella			1
ODONATA			
Argia		1	3
Basiaeschna janata			-99
Calopteryx			-99
Enallagma			9
Macromia		1	
TRICHOPTERA			
Cernotina		1	
Cheumatopsyche	167	1	5
Chimarra	15		
Oecetis			1
Polycentropus	1		
Triaenodes			3
TRICLADIDA			
Planariidae			3
TUBIFICIDA			
Branchiura sowerbyi		2	

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804057], Station #2, Sample Date: 9/23/2008 2:20:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Enchytraeidae	1		
Tubificidae	7	24	
VENEROIDEA			
Sphaeriidae	1		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804058], Station #3, Sample Date: 9/23/2008 4:45:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina			3
AMPHIPODA			
Hyalella azteca		1	36
COLEOPTERA			
Berosus	1		
Dubiraphia		2	2
Hydrobius		1	
Stenelmis	113	2	
DECAPODA			
Orconectes virilis			1
Palaemonetes kadiakensis			-99
DIPTERA			
Ablabesmyia		41	5
Ceratopogoninae	13	1	
Chironomidae	2	2	
Cladotanytarsus	6	37	3
Corynoneura	5		2
Cricotopus bicinctus			1
Cricotopus/Orthocladius	3		2
Cryptochironomus		3	
Dicrotendipes		8	
Glyptotendipes		6	
Hemerodromia	5		
Hexatoma	2		
Labrundinia			9
Microtendipes	1		1
Nilotanypus	1		
Paratanytarsus			12
Paratendipes		2	1
Phaenopsectra		2	1
Polypedilum aviceps	2		
Polypedilum convictum	86	1	4
Polypedilum halterale grp		2	3
Polypedilum illinoense grp	2		2
Polypedilum scalaenum grp	7	3	
Procladius		1	
Pseudochironomus		1	
Rheotanytarsus	26		7
Simulium	39		1

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804058], Station #3, Sample Date: 9/23/2008 4:45:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Stempellinella	1		
Stictochironomus		5	
Tabanus	-99		
Tanytarsus	7	49	39
Thienemanniella	2		2
Thienemannimyia grp.	2		3
Tipula			1
Zavrelimyia	1		
EPHEMEROPTERA			
Acerpenna	51		20
Baetis	44		
Caenis latipennis	11	85	137
Procloeon		24	2
Stenacron		1	
Stenonema femoratum	21	37	10
ISOPODA			
Caecidotea	6	2	
LIMNOPHILA			
Menetus			1
ODONATA			
Argia			2
Enallagma			7
RHYNCHOBDELLIDA			
Glossiphoniidae			-99
TRICHOPTERA			
Cheumatopsyche	159	1	18
Chimarra	41		-99
Hydroptila	1		
Triaenodes			2
TUBIFICIDA			
Branchiura sowerbyi	1		
Enchytraeidae	1		
Tubificidae	9	2	
VENEROIDEA			
Corbicula	1		
Sphaeriidae	13	1	

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804059], Station #4, Sample Date: 9/24/2008 10:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		4	4
AMPHIPODA			
Crangonyx			1
Hyalella azteca		1	74
COLEOPTERA			
Berosus			1
Dubiraphia		3	6
Helichus lithophilus			2
Hydrophilidae		1	
Scirtidae			2
Stenelmis	1	4	
DECAPODA			
Orconectes virilis			-99
DIPTERA			
Ablabesmyia		8	5
Ceratopogoninae	7	1	
Cladotanytarsus	13	5	1
Corynoneura	3		1
Cricotopus bicinctus		1	
Cricotopus/Orthocladius	3		
Cryptochironomus		2	
Dicrotendipes		7	
Diptera		1	
Eukiefferiella	2		
Glyptotendipes		2	2
Gonomyia	1		
Labrundinia			2
Microtendipes			2
Nanocladius			1
Ormosia	4		
Paratanytarsus	1	3	3
Paratendipes		5	
Polypedilum aviceps	1		
Polypedilum convictum	102		4
Polypedilum fallax grp	2		
Polypedilum illinoense grp	3	5	4
Polypedilum scalaenum grp	1	2	
Rheotanytarsus	7		7
Simulium	23		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804059], Station #4, Sample Date: 9/24/2008 10:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Stempellinella			1
Stictochironomus		28	
Tanytarsus	4	33	8
Thienemanniella	5		
Thienemannimyia grp.	9		4
Zavrelimyia			1
EPHEMEROPTERA			
Acerpenna	132		4
Baetis	78		
Caenis latipennis	21	150	92
Caenis punctata			1
Centroptilum		3	1
Leptophlebiidae			2
Procloeon		3	
Stenacron			2
Stenonema femoratum	54	43	13
HEMIPTERA			
Metrobates	1		
Neoplea			1
ISOPODA			
Caecidotea	1		
LIMNOPHILA			
Menetus			4
Physella			5
LUMBRICINA			
Lumbricina	1		
ODONATA			
Argia			2
Enallagma			18
PLECOPTERA			
Perlesta	3		
TRICHOPTERA			
Cheumatopsyche	150		
Chimarra	6		
Triaenodes			10
TUBIFICIDA			
Branchiura sowerbyi		1	
Enchytraeidae			2
Tubificidae	1	6	1

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804060], Station #4.1, Sample Date: 9/24/2008 11:20:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		12	5
AMPHIPODA			
Hyalella azteca			46
COLEOPTERA			
Berosus			1
Dineutus			-99
Dubiraphia		1	2
Dytiscidae		1	
Helichus lithophilus			2
Peltodytes			1
Psephenus herricki	-99		
Stenelmis	14	10	
DECAPODA			
Orconectes virilis		-99	1
DIPTERA			
Ablabesmyia	2	9	2
Ceratopogoninae	1	2	
Cladotanytarsus	9	16	
Corynoneura		1	
Cricotopus bicinctus	1		
Cricotopus/Orthocladius	10		
Dicrotendipes		5	1
Glyptotendipes			1
Hexatoma	-99		
Nilotanypus	2		
Ormosia	3	18	
Paracladopelma		2	
Paratanytarsus		2	17
Polypedilum aviceps	1		
Polypedilum convictum	100	2	
Polypedilum illinoense grp	8		1
Polypedilum scalaenum grp	12	3	
Pseudochironomus		2	
Rheotanytarsus	23		6
Simulium	17		
Stempellinella	2	1	
Stictochironomus	5	2	
Tanytarsus	14	31	14
Thienemanniella	5		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804060], Station #4.1, Sample Date: 9/24/2008 11:20:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Thienemannimyia grp.	8	2	
EPHEMEROPTERA			
Acerpenna	118		4
Baetis	64		
Caenis latipennis	40	114	153
Centroptilum			1
Procloeon		14	4
Stenacron		1	
Stenonema femoratum	66	65	26
HEMIPTERA			
Gerris			1
LIMNOPHILA			
Ancylidae			2
Physella	1		4
LUMBRICINA			
Lumbricina	-99		
ODONATA			
Dromogomphus	1		
Enallagma			7
Erythemis			2
Hagenius brevistylus			1
PLECOPTERA			
Perlesta	1		
TRICHOPTERA			
Cernotina		1	
Cheumatopsyche	150		3
Chimarra	10		
Oecetis		1	
Triaenodes			2
TUBIFICIDA			
Branchiura sowerbyi		-99	
Tubificidae	1		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804061], Station #5, Sample Date: 9/24/2008 2:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		1	4
AMPHIPODA			
Hyalella azteca			109
ARHYNCHOBDELLIDA			
Erpobdellidae	-99		
COLEOPTERA			
Berosus	2	1	1
Dubiraphia		3	3
Stenelmis	22	3	
DIPTERA			
Ablabesmyia	4	12	7
Ceratopogoninae		1	
Chironomus	1	10	
Cladotanytarsus	5	39	1
Corynoneura	3	1	
Cricotopus bicinctus	1	1	
Cricotopus/Orthocladius	6	1	
Cryptochironomus	1	1	
Dicrotendipes	1	5	2
Diptera		1	
Dolichopodidae		1	
Eukiefferiella	4		
Glyptotendipes			2
Gonomyia		1	
Hemerodromia	1		
Labrundinia			4
Larsia	1		
Nanocladius		1	2
Nilotanypus	2		
Paracladopelma		1	
Parametriocnemus	1		
Paratanytarsus	2	2	14
Paratendipes		2	
Polypedilum convictum	107		1
Polypedilum halterale grp		1	
Polypedilum illinoense grp	8	3	1
Polypedilum scalaenum grp	5	6	1
Pseudochironomus		1	
Rheocricotopus	1		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804061], Station #5, Sample Date: 9/24/2008 2:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Rheotanytarsus	9		1
Simulium	112		
Stempellinella			3
Stictochironomus		14	
Tanytarsus	5	43	28
Thienemannimyia grp.	20		1
Tipula		1	
Zavrelimyia	2		
EPHEMEROPTERA			
Acerpenna	52		
Baetis	54		
Caenis latipennis	42	117	143
Caenis punctata		3	5
Centroptilum			2
Procloeon		5	4
Stenacron			1
Stenonema femoratum	37	12	22
ISOPODA			
Caecidotea	3		
LIMNOPHILA			
Ancylidae		1	
Gyraulus	1		
Physella		2	6
LUMBRICINA			
Lumbricidae	1		
ODONATA			
Argia			1
Calopteryx		1	
Enallagma		1	6
Gomphidae		1	
Ischnura			1
Libellulidae			1
PLECOPTERA			
Perlesta	1		
TRICHOPTERA			
Cheumatopsyche	103		
Chimarra	10		
TUBIFICIDA			
Enchytraeidae	1	1	
Tubificidae		2	

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804062], Station #6.1, Sample Date: 9/24/2008 4:50:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
N/A			
Chordodidae			1
"HYDRACARINA"			
Acarina	1	2	
AMPHIPODA			
Hyalella azteca		2	79
ARHYNCHOBDELLIDA			
Erpobdellidae	1		
COLEOPTERA			
Berosus			1
Dubiraphia			5
Enochrus	1		
Psephenus herricki	2		
Stenelmis	55	13	1
DECAPODA			
Orconectes virilis			-99
DIPTERA			
Ablabesmyia		8	9
Ceratopogoninae			1
Chironomidae	1	1	3
Chironomus		3	4
Chrysops	1		
Cladotanytarsus	2	15	
Corynoneura	2	1	
Cricotopus/Orthocladius	6	1	
Cryptochironomus		2	
Demicryptochironomus	1		
Dicrotendipes		3	11
Diptera		1	
Endochironomus			4
Eukiefferiella	1		
Glyptotendipes	1	1	6
Hexatoma		1	
Labrundinia	1		4
Larsia	4		
Microtendipes			5
Nanocladius	1	2	4
Nilotanypus	3		
Ormosia	1		
Parachironomus			11

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804062], Station #6.1, Sample Date: 9/24/2008 4:50:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Parametriocnemus	2		
Paratanytarsus	1	2	19
Polypedilum			4
Polypedilum convictum	116		1
Polypedilum halterale grp	30	5	5
Polypedilum scalaenum grp		6	1
Rheotanytarsus	6		5
Saetheria			1
Simulium	28		
Stempellinella	1		2
Stenochironomus			1
Stictochironomus		4	
Tabanus	1		
Tanytarsus	2	12	44
Thienemanniella	1		
Thienemannimyia grp.	27	2	1
EPHEMEROPTERA			
Acerpenna	17		
Baetis	68		
Caenis latipennis	15	93	76
Caenis punctata		1	20
Callibaetis			2
Centroptilum			8
Choroterpes		1	
Procloeon		6	
Stenacron	1		1
Stenonema femoratum	12	67	21
HEMIPTERA			
Belostoma			-99
ISOPODA			
Caecidotea	4	1	
LIMNOPHILA			
Lymnaeidae		1	
Menetus			2
Physella	1	3	23
ODONATA			
Calopteryx			-99
Coenagrionidae	1		
Enallagma			13
Epicordulia			1
Erythemis			-99

Aquid Invertebrate Database Bench Sheet Report
Dardenne Ck [0804062], Station #6.1, Sample Date: 9/24/2008 4:50:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Libellula			-99
Tramea			-99
PLECOPTERA			
Perlesta	1		
TRICHOPTERA			
Cheumatopsyche	182		3
Chimarra	7		
Hydropsyche	1		
Triaenodes			5
TRICLADIDA			
Planariidae	1		6
TUBIFICIDA			
Branchiura sowerbyi		6	
Enchytraeidae		1	
Tubificidae	1	17	

Aquid Invertebrate Database Bench Sheet Report
Big Ck [0804094], Station #1, Sample Date: 9/29/2008 5:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		1	1
AMPHIPODA			
Crangonyx	2	1	1
Hyalella azteca		1	11
COLEOPTERA			
Berosus		2	
Dubiraphia		2	4
Ectopria nervosa	-99		
Stenelmis	42	22	2
DECAPODA			
Orconectes virilis			1
DIPTERA			
Ablabesmyia	1	10	1
Anopheles			6
Ceratopogoninae		1	
Chironomidae	6	6	
Chironomus	1	3	1
Chrysops			1
Cladotanytarsus	7	20	
Corynoneura	2	1	1
Cricotopus bicinctus	52	7	11
Cricotopus/Orthocladius	53	1	8
Cryptochironomus		3	
Dicrotendipes		8	
Ephydridae		1	
Glyptotendipes		1	
Gonomyia	3		
Hemerodromia	2		
Hexatoma	1	1	
Labrundinia	4		11
Microtendipes	1	4	
Nanocladius	1	1	
Nilotanypus	1		1
Paracladopelma		1	
Parametriocnemus	1		
Paratanytarsus		8	11
Paratendipes	1	21	
Phaenopsectra	2	4	1
Polypedilum	1		

Aquid Invertebrate Database Bench Sheet Report
Big Ck [0804094], Station #1, Sample Date: 9/29/2008 5:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum aviceps	1		
Polypedilum convictum	69		
Polypedilum halterale grp		3	
Polypedilum illinoense grp	32		10
Polypedilum scalaenum grp	6	9	
Pseudochironomus		1	
Rheocricotopus	1		
Rheotanytarsus	38		3
Simulium	93	4	
Stempellinella	1		1
Stictochironomus		21	
Tanytarsus	27	45	28
Thienemanniella	47		
Thienemannimyia grp.	6		1
Tribelos		2	
Zavrelimyia	4	1	1
EPHEMEROPTERA			
Acentrella	11		
Acerpenna	11		
Baetis	52		
Caenis latipennis	13	55	169
Centroptilum		1	1
Paracloeodes		1	
Procloeon		1	1
Stenacron		2	1
Stenonema femoratum	34	42	5
Tricorythodes			1
HEMIPTERA			
Microvelia			1
Trepobates			1
LIMNOPHILA			
Physella			6
ODONATA			
Argia			1
Basiaeschna janata			1
Calopteryx			1
Corduliidae		1	
Dromogomphus		1	
Enallagma		1	10
PLECOPTERA			
Perlesta	6		

Aquid Invertebrate Database Bench Sheet Report
Big Ck [0804094], Station #1, Sample Date: 9/29/2008 5:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
TRICHOPTERA			
Cheumatopsyche	65		
Chimarra	3		
Phryganeidae		1	
Triaenodes			5
TUBIFICIDA			
Tubificidae		1	
VENEROIDEA			
Sphaeriidae			1

Aquid Invertebrate Database Bench Sheet Report
Hays Ck [0804096], Station #1a, Sample Date: 9/30/2008 2:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		2	
AMPHIPODA			
Crangonyx	11	3	29
Gammarus	4		2
COLEOPTERA			
Dubiraphia			2
Dytiscidae	1		2
Helichus basalis	2		1
Helichus lithophilus			1
Stenelmis	51	6	
DECAPODA			
Orconectes virilis	2		
DIPTERA			
Ablabesmyia	5	3	1
Anopheles			3
Ceratopogoninae	1	1	
Chironomidae		1	
Chironomus	3	4	1
Cladotanytarsus	2		
Corynoneura		3	
Cricotopus bicinctus	6	1	3
Cricotopus/Orthocladius	14		
Cryptochironomus	2	2	
Demicryptochironomus	1		
Dicrotendipes		2	10
Diptera	3		
Eukiefferiella	1		
Hemerodromia	2		
Hexatoma	4		
Labrundinia			2
Larsia			1
Microtendipes	1	10	4
Nilotanypus	2		
Ormosia		1	
Paracladopelma	1	1	
Parametriocnemus	3		
Paratanytarsus	2	3	32
Paratendipes	7	9	
Phaenopsectra		2	4

Aquid Invertebrate Database Bench Sheet Report
Hays Ck [0804096], Station #1a, Sample Date: 9/30/2008 2:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum convictum	81		1
Polypedilum fallax grp	1		1
Polypedilum illinoense grp	24	1	13
Polypedilum scalaenum grp		3	
Rheocricotopus	1		
Rheotanytarsus	30	1	1
Simulium	47		
Stempellinella	1	1	1
Stictochironomus	2	5	
Tanytarsus	72	28	32
Thienemanniella	14		
Thienemannimyia grp.	6		
Zavrelimyia	1	1	
EPHEMEROPTERA			
Acerpenna	1		
Baetis	29		
Caenis latipennis	152	152	150
Callibaetis			1
Procloeon			1
Stenacron		1	1
Stenonema femoratum	57	28	14
ISOPODA			
Caecidotea	8	1	19
LIMNOPHILA			
Physella	3	1	
ODONATA			
Argia		1	
Calopteryx			-99
Enallagma			3
Somatochlora			1
PLECOPTERA			
Perlesta	4		
TRICHOPTERA			
Cheumatopsyche	111		
TRICLADIDA			
Planariidae			1
TUBIFICIDA			
Branchiura sowerbyi	2	1	
Enchytraeidae	2	1	2
Tubificidae	23		1

Aquid Invertebrate Database Bench Sheet Report
Hays Ck [0804096], Station #1a, Sample Date: 9/30/2008 2:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
VENEROIDEA			
Sphaeriidae	1		

Aquid Invertebrate Database Bench Sheet Report
North Fk Cuivre R [0804063], Station #1, Sample Date: 9/25/2008 3:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	1	3	
AMPHIPODA			
Stygobromus		1	
COLEOPTERA			
Berosus			3
Dubiraphia		1	3
Dytiscidae		2	1
Helichus basalis			2
Peltodytes		1	
Stenelmis	39	17	6
DIPTERA			
Ablabesmyia		6	
Ceratopogoninae		6	
Cladotanytarsus		15	
Cricotopus/Orthocladius	8		5
Cryptochironomus	1	3	
Dicrotendipes		2	
Eukiefferiella	4		
Hemerodromia	1		
Labrundinia		1	2
Nilotanypus	1		1
Ormosia		1	
Paratanytarsus			12
Paratendipes		12	
Polypedilum aviceps	1		
Polypedilum convictum	151		6
Polypedilum illinoense grp		5	
Polypedilum scalaenum grp	1	1	
Rheotanytarsus	11		29
Simulium	70		
Stictochironomus		4	
Tanytarsus	1	14	15
Thienemanniella	6		3
Thienemannimyia grp.	7		2
Tribelos		2	
EPHEMEROPTERA			
Acerpenna	23		
Baetis	98		1
Caenis latipennis	8	161	195

Aquid Invertebrate Database Bench Sheet Report
North Fk Cuivre R [0804063], Station #1, Sample Date: 9/25/2008 3:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Caenis punctata		2	
Stenacron	1		
Stenonema femoratum	15	14	
Tricorythodes	1		1
ISOPODA			
Caecidotea (Blind & Unpigmented)		1	
LIMNOPHILA			
Physella	-99		
LUMBRICINA			
Lumbricidae			1
LUMBRICULIDA			
Lumbriculidae		-99	
ODONATA			
Enallagma			6
Tetragoneuria			-99
TRICHOPTERA			
Cheumatopsyche	185		17
Triaenodes			3
TUBIFICIDA			
Enchytraeidae			1
Tubificidae	1	17	
VENEROIDEA			
Sphaeriidae	2	1	

Aquid Invertebrate Database Bench Sheet Report
South R [0804100], Station #1, Sample Date: 10/1/2008 9:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
N/A			
Gordiidae	-99		
"HYDRACARINA"			
Acarina	1	1	
AMPHIPODA			
Crangonyx		3	1
Gammarus	5		16
Hyalella azteca			9
ARHYNCHOBDELLIDA			
Erpobdellidae		1	
BRANCHIOBDELLIDA			
Branchiobdellida			1
COLEOPTERA			
Dubiraphia		5	41
Dytiscidae		3	
Helichus basalis			1
Helichus lithophilus			1
Macronychus glabratus			1
Stenelmis	19	9	10
DECAPODA			
Orconectes luteus			1
Orconectes virilis	-99		-99
DIPTERA			
Ablabesmyia	1	20	2
Ceratopogoninae		3	1
Chironomidae	2		
Chironomus		24	1
Cladotanytarsus		2	1
Corynoneura	4		2
Cricotopus bicinctus	4		2
Cricotopus trifascia	1		
Cricotopus/Orthocladius	49	3	3
Cryptochironomus		6	
Dicrotendipes		3	2
Eukiefferiella	5		
Glyptotendipes			1
Hemerodromia	3		
Labrundinia		1	3
Mesosmittia		1	
Microtendipes		6	2

Aquid Invertebrate Database Bench Sheet Report
South R [0804100], Station #1, Sample Date: 10/1/2008 9:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Nanocladius	1	2	1
Nilotanypus		1	
Parakiefferiella		1	
Parametriocnemus	4		
Paratanytarsus			11
Paratendipes		1	
Phaenopsectra		1	4
Polypedilum aviceps	13		
Polypedilum convictum	125		5
Polypedilum fallax grp			2
Polypedilum illinoense grp	3	3	2
Polypedilum scalaenum grp		7	
Rheotanytarsus	4		14
Saetheria	3	1	
Simulium	140		6
Stenochironomus			1
Stictochironomus		42	
Tabanus	-99		
Tanytarsus	8	51	8
Thienemanniella	5		1
Thienemannimyia grp.	4	2	20
EPHEMEROPTERA			
Baetis	151		1
Caenis latipennis		19	29
Stenacron	6	2	3
Stenonema femoratum		8	2
Tricorythodes	11		12
ISOPODA			
Caecidotea	5	9	31
LIMNOPHILA			
Menetus			2
ODONATA			
Argia		1	3
Calopteryx			13
Enallagma			23
Hetaerina			4
Libellulidae			1
PLECOPTERA			
Perlidae	1		
RHYNCHOBDELLIDA			

Aquid Invertebrate Database Bench Sheet Report
South R [0804100], Station #1, Sample Date: 10/1/2008 9:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Glossiphoniidae			1
TRICHOPTERA			
Cheumatopsyche	50		2
Chimarra	2		
Hydropsyche	3		
Hydroptila	3		
Oecetis			2
Triaenodes	1		23
TRICLADIDA			
Planariidae			2
TUBIFICIDA			
Branchiura sowerbyi		1	
Enchytraeidae	1		
Tubificidae	6	58	
VENEROIDEA			
Sphaeriidae	2		-99

Aquid Invertebrate Database Bench Sheet Report
Sugar Ck [0804143], Station #1, Sample Date: 4/2/2008 1:15:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	1		
AMPHIPODA			
Crangonyx	38	43	202
COLEOPTERA			
Heterosternuta		2	1
DIPTERA			
Caloparyphus	2		
Ceratopogoninae		2	
Chaoborus		1	
Chironomidae		4	1
Clinocera	1	1	
Cricotopus/Orthocladius	6		
Eukiefferiella	7		1
Glyptotendipes		1	
Hexatoma	2		
Hydrobaenus	15	212	1
Orthocladius (Euorthocladius)	1		
Paratendipes		1	
Prosimulium	234		24
Rheocricotopus		2	3
Silvius	-99		
Tvetenia	1		
HEMIPTERA			
Trichocorixa		1	
ISOPODA			
Caecidotea	8	2	19
LIMNOPHILA			
Physella		-99	
LUMBRICINA			
Lumbricina	-99	-99	
MESOGASTROPODA			
Hydrobiidae		1	
PLECOPTERA			
Amphinemura	7		2
Isoperla	286	3	10
Zealeuctra	5		
TRICHOPTERA			
Agapetus	2		

Aquid Invertebrate Database Bench Sheet Report
Sugar Ck [0804143], Station #1, Sample Date: 4/2/2008 1:15:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Ironoquia			2
Neophylax	2		
Polycentropodidae			1
Rhyacophila	6		
TRICLADIDA			
Planariidae	10		
TUBIFICIDA			
Enchytraeidae	3	3	
Limnodrilus hoffmeisteri		1	
Tubificidae	1	6	

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930054], Station #1, Sample Date: 4/7/2009 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	3	1	
AMPHIPODA			
Gammarus			-99
Hyalella azteca	1	6	1
COLEOPTERA			
Neoporus			3
Scirtidae			1
Stenelmis	15	1	
DECAPODA			
Palaemonetes kadiakensis			1
DIPTERA			
Ablabesmyia		19	7
Ceratopogoninae	1	1	1
Chironomidae	5	4	2
Chironomus		48	4
Cladotanytarsus	12	49	1
Clinocera	2		
Corynoneura		1	1
Cricotopus bicinctus	4	1	
Cricotopus/Orthocladius	185	10	34
Cryptochironomus	8	3	1
Dicrotendipes	2		
Diptera		1	
Eukiefferiella	13		
Hemerodromia	3		
Hydrobaenus	1	18	5
Labrundinia			1
Nanocladius			2
Nilotanypus	2	1	2
Nilothauma	1		
Paracladopelma		13	
Parakiefferiella			1
Parametriocnemus	2		
Paratanytarsus		3	13
Paratendipes		4	1
Phaenopsectra	1	9	1
Polypedilum aviceps	194	1	5
Polypedilum convictum	12		
Polypedilum halterale grp		3	

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930054], Station #1, Sample Date: 4/7/2009 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum illinoense grp		3	14
Polypedilum scalaenum grp	10	42	1
Rheotanytarsus	70	1	8
Saetheria	1		
Simulium	20		4
Stempellinella		1	
Stictochironomus	1	4	
Tanytarsus	57	36	30
Thienemanniella	2		17
Thienemannimyia grp.	25	3	18
Tipula	-99		
EPHEMEROPTERA			
Acentrella	33		6
Acerpenna	45		87
Caenis latipennis	14	18	101
Centroptilum			1
Heptageniidae	5		
Stenacron	1		
Stenonema femoratum	12	1	1
LIMNOPHILA			
Menetus			1
LUMBRICINA			
Lumbricina	-99		
ODONATA			
Argia			3
Enallagma			5
Gomphus		1	
PLECOPTERA			
Haploperla	6		
Perlesta	24		4
TRICHOPTERA			
Cheumatopsyche	27		
Chimarra	6		
Hydroptila	3		
Pycnopsyche			-99
Rhyacophila	-99		
Triaenodes			2
TRICLADIDA			
Planariidae	1		1
TUBIFICIDA			

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930054], Station #1, Sample Date: 4/7/2009 10:45:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Enchytraeidae			1
Limnodrilus hoffmeisteri	6		
Tubificidae	11	1	
VENEROIDA			
Corbicula			-99

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930055], Station #2, Sample Date: 4/7/2009 12:40:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina			1
AMPHIPODA			
Crangonyx	-99	6	4
Gammarus			-99
Hyalella azteca			6
COLEOPTERA			
Dubiraphia			4
Dytiscidae		1	
Peltodytes		1	
Stenelmis	5		
DIPTERA			
Ablabesmyia		9	4
Ceratopogoninae	9	2	
Chironomidae	5	2	2
Chironomus	1	34	1
Chrysops	1		
Cladotanytarsus	132	76	4
Clinocera	2		
Corynoneura	6	5	
Cricotopus bicinctus	3		3
Cricotopus/Orthocladius	106	7	25
Cryptochironomus	3	5	
Dicrotendipes	1	1	
Diptera	1	1	
Eukiefferiella	2		
Glyptotendipes		4	
Hemerodromia	1		1
Hexatoma	-99		
Hydrobaenus	40	32	3
Labrundinia			4
Nilotanypus	8		15
Ormosia	1		
Paracladopelma		5	
Parametriocnemus	1		
Paratanytarsus		1	13
Paratendipes		23	
Phaenopsectra	1	7	7
Polypedilum aviceps	106		4
Polypedilum convictum	3		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930055], Station #2, Sample Date: 4/7/2009 12:40:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum halterale grp		2	
Polypedilum illinoense grp	2	1	1
Polypedilum scalaenum grp	14	20	
Rheocricotopus	1		
Rheotanytarsus	3		10
Saetheria	6	1	
Simulium	8		
Stempellinella	1	5	1
Stictochironomus		3	
Tanytarsus	14	13	36
Thienemanniella	17		4
Thienemannimyia grp.	28		12
Tipula			-99
Zavrelimyia	1	1	
EPHEMEROPTERA			
Acentrella	68		15
Acerpenna	25		44
Baetis	3		
Caenis latipennis	5	11	105
Heptageniidae	6		
Procloeon			1
Stenacron			1
Stenonema femoratum	13	1	2
ISOPODA			
Caecidotea	-99	1	
LIMNOPHILA			
Physella			-99
LUMBRICINA			
Lumbricina		-99	
MEGALOPTERA			
Sialis			-99
ODONATA			
Argia			1
Basiaeschna janata			-99
Calopteryx			-99
Enallagma			2
Progomphus obscurus		1	
PLECOPTERA			
Amphinemura	1		1
Haploperla	5		
Isoperla	5		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930055], Station #2, Sample Date: 4/7/2009 12:40:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Perlesta	16		2
TRICHOPTERA			
Cheumatopsyche	1		1
Chimarra	-99		
Pycnopsyche			-99
Rhyacophila	-99		-99
Triaenodes			1
TUBIFICIDA			
Branchiura sowerbyi		1	
Limnodrilus hoffmeisteri	1	2	
Tubificidae	2	7	1
VENEROIDA			
Corbicula			1
Pisidiidae			1

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930056], Station #3, Sample Date: 4/7/2009 3:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	1		
AMPHIPODA			
Hyalella azteca			1
COLEOPTERA			
Peltodytes			1
Stenelmis	27		
DIPTERA			
Ablabesmyia	3	16	1
Ceratopogoninae	12	5	
Chironomidae	3	5	5
Chironomus	1	62	
Cladotanytarsus	14	35	2
Clinocera	1		
Corynoneura		2	6
Cricotopus bicinctus	4		24
Cricotopus/Orthocladius	118	17	159
Cryptochironomus	1	4	
Demicryptochironomus	1		
Diamesa	1		
Dicrotendipes		4	1
Eukiefferiella	2		
Hemerodromia	6		
Hexatoma	-99		
Hydrobaenus	6	34	7
Labrundinia			2
Micropsectra			2
Muscidae		2	
Nilotanypus	2		7
Paracladopelma		5	
Parametriocnemus		1	
Paratanytarsus	1	1	4
Paratendipes		12	
Phaenopsectra		1	1
Polypedilum aviceps	156	1	1
Polypedilum fallax grp	1		
Polypedilum illinoense grp	1		27
Polypedilum scalaenum grp	12	16	
Rheotanytarsus	13		3
Simulium	17	1	

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930056], Station #3, Sample Date: 4/7/2009 3:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Stictochironomus	3	1	
Tabanus	-99		
Tanytarsus	8	18	14
Thienemanniella	3		8
Thienemannimyia grp.	33	3	7
Tipula	1		
Zavrelimyia	2		
EPHEMEROPTERA			
Acentrella	49		6
Acerpenna	51		51
Baetis	1		1
Caenis latipennis	8	13	23
Heptageniidae	5		
Leptophlebiidae	1		1
Stenonema femoratum	29	2	3
ISOPODA			
Caecidotea	23	2	
LIMNOPHILA			
Ancylidae	2		
ODONATA			
Dromogomphus	1		
Enallagma			1
PLECOPTERA			
Amphinemura	4		
Haploperla	4		
Hydroperla crosbyi	-99		
Isoperla	20		
Perlesta	40		2
TRICHOPTERA			
Cheumatopsyche	10		1
Chimarra	6		
Hydroptila	1		
Ironoquia			-99
Ochrotrichia	1		
Polycentropus			1
Pycnopsyche			-99
Rhyacophila	1		
TUBIFICIDA			
Enchytraeidae		1	
Limnodrilus hoffmeisteri	2		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930056], Station #3, Sample Date: 4/7/2009 3:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Tubificidae	6	1	
VENEROIDA			
Corbicula	-99		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930058], Station #4, Sample Date: 4/8/2009 10:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		1	
AMPHIPODA			
Hyalella azteca			1
COLEOPTERA			
Agabus			2
Dytiscidae		5	
Peltodytes			2
Stenelmis	1	2	
DECAPODA			
Orconectes virilis			-99
Palaemonetes kadiakensis		-99	
DIPTERA			
Ablabesmyia	1	10	4
Ceratopogoninae	9	1	
Chironomidae	1	3	
Chironomus		47	1
Cladotanytarsus	48	71	3
Corynoneura		3	3
Cricotopus/Orthocladius	159	17	129
Cryptochironomus	3	5	
Dicrotendipes		1	1
Diptera		6	
Eukiefferiella	1		
Hemerodromia	5		
Hydrobaenus	4	20	5
Micropsectra		1	3
Microtendipes	1		
Nanocladius			1
Nilotanypus	1	1	
Orthocladius (Euorthocladius)	1		
Parametriocnemus	2		
Paratanytarsus			10
Paratendipes	1	16	
Phaenopsectra		1	
Polypedilum aviceps	184		4
Polypedilum illinoense grp		2	7
Polypedilum scalaenum grp	22	38	
Pseudochironomus	1		1
Rheocricotopus	2		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930058], Station #4, Sample Date: 4/8/2009 10:00:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Rheotanytarsus	12	1	9
Saetheria	3	12	
Simulium	11		
Stempellinella		1	
Stenochironomus			1
Stictochironomus		3	
Tanytarsus	11	10	20
Thienemanniella	8	2	6
Thienemannimyia grp.	55		6
Zavrelimyia			2
EPHEMEROPTERA			
Acentrella	146		37
Acerpenna	15		12
Baetis	6		
Caenis latipennis	12	16	39
Centroptilum		2	
Heptageniidae	5		1
Stenonema femoratum	36	6	4
ISOPODA			
Caecidotea	8		1
ODONATA			
Dromogomphus		-99	
Enallagma			5
Libellula			1
PLECOPTERA			
Amphinemura	7		3
Haploperla	2		
Isoperla	7		
Perlesta	33		5
TRICHOPTERA			
Cheumatopsyche	10		1
Chimarra	1		
Hydroptila			1
Ironoquia			1
Oecetis		1	
Rhyacophila	1		
Triaenodes			1
TUBIFICIDA			
Enchytraeidae		2	
Tubificidae			2

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930059], Station #4.1, Sample Date: 4/8/2009 1:15:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina			1
AMPHIPODA			
Hyalella azteca		1	6
COLEOPTERA			
Agabus			1
Berosus			1
Dubiraphia		1	1
Dytiscidae			1
Neoporus			-99
Stenelmis	8	1	
DECAPODA			
Orconectes virilis			1
DIPTERA			
Ablabesmyia		5	11
Ceratopogoninae	3	14	3
Chironomidae	2	3	3
Chironomus		33	
Cladotanytarsus	22	98	3
Clinocera		1	
Corynoneura	7	16	29
Cricotopus/Orthocladius	95	33	58
Cryptochironomus		2	
Cryptotendipes			1
Dicrotendipes	1	10	4
Diptera			2
Eukiefferiella	3		
Glyptotendipes			1
Gonomyia		3	
Hemerodromia	7	1	1
Hexatoma	1		
Hydrobaenus	11	91	13
Labrundinia	2		3
Nanocladius			3
Nilotanypus	2		4
Parakiefferiella			1
Parametriocnemus		2	
Paratanytarsus		2	11
Paratendipes		8	2
Phaenopsectra		1	2

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930059], Station #4.1, Sample Date: 4/8/2009 1:15:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum aviceps	95		1
Polypedilum halterale grp		1	
Polypedilum scalaenum grp	8	21	6
Pseudochironomus		1	
Pseudosmittia		1	
Rheotanytarsus	1	1	5
Saetheria	3	3	
Simulium	33		
Stempellinella	1		
Stenochironomus			4
Stictochironomus		2	
Tabanus	-99		
Tanytarsus	4	13	16
Thienemanniella	15		5
Thienemannimyia grp.	25	6	9
Zavrelimyia	2	24	2
EPHEMEROPTERA			
Acentrella	146		2
Acerpenna	20	1	6
Baetis			1
Caenis latipennis	1	6	50
Centroptilum			3
Heptageniidae	2	2	1
Leptophlebiidae			1
Stenonema femoratum	7	4	11
ISOPODA			
Caecidotea	10	2	
LIMNOPHILA			
Ancylidae			1
Menetus			1
Physella		1	-99
ODONATA			
Argia			-99
Boyeria			1
Calopteryx			8
Enallagma			1
PLECOPTERA			
Amphinemura	14		
Clioperla clio	-99		
Haploperla	8		
Isoperla	11		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930059], Station #4.1, Sample Date: 4/8/2009 1:15:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Perlesta	31		1
TRICHOPTERA			
Cheumatopsyche	4		
Chimarra	1		
Ironoquia			-99
Ochrotrichia	9		
Polycentropus	-99		1
Pycnopsyche			-99
Rhyacophila	1		
Triaenodes			1
TUBIFICIDA			
Branchiura sowerbyi		1	
Enchytraeidae	1	1	
Tubificidae		1	

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930060], Station #5, Sample Date: 4/8/2009 1:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		2	2
AMPHIPODA			
Hyalella azteca			14
COLEOPTERA			
Paracymus		1	
Stenelmis	13		
DIPTERA			
Ablabesmyia	1	4	8
Ceratopogoninae	16	4	
Chironomidae	3	4	7
Chironomus		70	13
Cladotanytarsus	19	85	7
Corynoneura	3		13
Cricotopus bicinctus			6
Cricotopus/Orthocladius	219	18	116
Cryptochironomus	2	1	
Demicryptochironomus	1		
Dicrotendipes	1	4	4
Diptera		4	
Ephydridae		1	
Eukiefferiella	1	1	
Forcipomyiinae			1
Hemerodromia	4		
Hydrobaenus		20	17
Labrundinia			2
Micropsectra	1	7	10
Nanocladius			2
Nilotanypus	1		2
Parakiefferiella			1
Parametriocnemus	5		
Paratanytarsus		1	13
Paratendipes		24	
Phaenopsectra	1	1	
Polypedilum aviceps	85		3
Polypedilum illinoense grp			1
Polypedilum scalaenum grp	48	27	
Prosimulium	10		
Psychoda		2	1
Rheotanytarsus	1		1

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930060], Station #5, Sample Date: 4/8/2009 1:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Saetheria	4		
Silvius	-99		
Stempellinella	2		1
Stictochironomus		3	
Tanytarsus	28	16	43
Thienemanniella	4		5
Thienemannimyia grp.	53	1	6
Zavrelimyia	5	2	
EPHEMEROPTERA			
Acentrella	47		6
Acerpenna	16		4
Baetis	12	2	
Caenis latipennis	6	19	46
Centroptilum			4
Heptageniidae	17		
Stenacron	1		
Stenonema femoratum	13		3
GORDIOIDEA			
Gordiidae	3		
ISOPODA			
Caecidotea	8	1	
Caecidotea (Blind & Unpigmented)	-99	1	
LIMNOPHILA			
Physella	-99		
ODONATA			
Basiaeschna janata			-99
Enallagma			-99
PLECOPTERA			
Amphinemura	6		
Haploperla	2		
Hydroperla	-99		
Isoperla	5		
Perlesta	29		
TRICHOPTERA			
Cheumatopsyche	3		
Rhyacophila	-99		
TUBIFICIDA			
Enchytraeidae	3	1	
Limnodrilus hoffmeisteri		1	
Tubificidae		1	

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930060], Station #5, Sample Date: 4/8/2009 1:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930057], Station #6.1, Sample Date: 4/7/2009 4:25:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		1	3
AMPHIPODA			
Hyalella azteca			21
COLEOPTERA			
Dubiraphia		1	2
Neoporus			3
Peltodytes		1	2
Stenelmis	2	2	1
DIPTERA			
Ablabesmyia		5	23
Aedes			1
Ceratopogoninae			5
Chaoborus		1	
Chironomidae	3	4	3
Chironomus		56	8
Cladotanytarsus	3	48	
Clinocera	2		
Corynoneura	13		2
Cricotopus/Orthocladius	179	22	76
Cryptochironomus	2	3	1
Dicrotendipes		5	4
Diptera		20	
Ephydridae			1
Eukiefferiella	7		
Glyptotendipes		1	1
Hemerodromia	5		
Hydrobaenus	12	23	15
Microtendipes		1	1
Nanocladius		1	1
Nilotanypus	12	1	1
Parachironomus			2
Parametriocnemus	4		
Paratanytarsus	1		11
Paratendipes		31	
Phaenopsectra		1	5
Polypedilum aviceps	98		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930060], Station #5, Sample Date: 4/8/2009 1:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum halterale grp	4	19	
Polypedilum illinoense grp			8
Polypedilum scalaenum grp	10	5	4
Procladius		1	
Pseudosmittia		1	
Psychoda		2	1
Rheocricotopus	3	1	
Rheotanytarsus	5	1	2
Saetheria	2	3	
Simulium	33		
Stempellinella	1	2	
Stictochironomus		9	1
Tabanus	-99		
Tanytarsus	5	15	62
Thienemanniella	20		2
Thienemannimyia grp.	28	1	3
Zavrelimyia	3	2	2
EPHEMEROPTERA			
Acentrella	74		
Acerpenna	14		
Baetis	1		
Caenis latipennis	4	20	31
Centroptilum			8
Heptageniidae	44	2	
Stenonema femoratum	8	7	5
GORDIOIDEA			
Gordiidae		1	
ISOPODA			
Caecidotea	6	2	
LIMNOPHILA			
Physella	1		-99
LUMBRICINA			
Lumbricina			-99
ODONATA			
Argia			-99
Boyeria			-99
Calopteryx			-99
Enallagma			1
Libellula			-99
PLECOPTERA			
Amphinemura	10		

Aquid Invertebrate Database Bench Sheet Report
Dardenne Cr [0930060], Station #5, Sample Date: 4/8/2009 1:30:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Isoperla	8		
Perlesta	44		
TRICHOPTERA			
Cheumatopsyche	1		-99
Hydroptilidae	1		
Polycentropodidae	1		
Rhyacophila	-99		
TRICLADIDA			
Planariidae			1
TUBIFICIDA			
Enchytraeidae		3	
Limnodrilus hoffmeisteri		2	
Tubificidae	1	8	

Aquid Invertebrate Database Bench Sheet Report
Big Cr [0930021], Station #1a, Sample Date: 3/23/2009 11:15:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	1	3	8
AMPHIPODA			
Crangonyx	-99	4	2
Hyalella azteca			2
BRANCHIOBDELLIDA			
Branchiobdellida	1		
COLEOPTERA			
Berosus			7
Dubiraphia	1		1
Stenelmis	51	8	2
DECAPODA			
Orconectes luteus	-99		1
DIPTERA			
Ablabesmyia		29	13
Ceratopogoninae	1	1	2
Chironomidae	5	1	
Chrysops	1		
Cladotanytarsus	3	9	2
Clinocera	16		
Corynoneura	2	5	6
Cricotopus bicinctus	47	2	10
Cricotopus/Orthocladius	257	22	27
Cryptochironomus	3	6	
Diamesa	1		
Dicrotendipes	3	16	8
Eukiefferiella	14		1
Hemerodromia	6		
Hexatoma	2	-99	1
Hydrobaenus	4	10	4
Labrundinia		1	7
Microtendipes		1	1
Nanocladius	1	1	3
Nilotanypus	1		
Nilothauma			1
Orthocladius (Euorthocladius)	1		
Paracladopelma		4	
Parametriocnemus	7		
Paratanytarsus	9	5	43
Paratendipes	2	15	1

Aquid Invertebrate Database Bench Sheet Report
Big Cr [0930021], Station #1a, Sample Date: 3/23/2009 11:15:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Phaenopsectra		2	3
Polypedilum aviceps	62	1	7
Polypedilum fallax grp			1
Polypedilum illinoense grp	1		1
Polypedilum scalaenum grp	5	16	
Prosimulium	9		1
Rheocricotopus	2		1
Rheotanytarsus	81	1	3
Simulium	29		1
Stempellinella	1	1	1
Stictochironomus		12	
Tanytarsus	132	48	43
Thienemanniella	11		2
Thienemannimyia grp.	50	6	4
Tipula			-99
Zavrelimyia	2		
EPHEMEROPTERA			
Acerpenna	23		
Caenis latipennis	18	17	49
Centroptilum			5
Stenacron	1		
Stenonema femoratum	14	26	9
HEMIPTERA			
Microvelia			3
LIMNOPHILA			
Ferrissia		1	
ODONATA			
Enallagma			2
PLECOPTERA			
Amphinemura	9		
Haploperla	7	1	
Isoperla	4		
Perlesta	8		
TRICHOPTERA			
Cheumatopsyche	25	1	
Chimarra	2		
Hydroptila	1		
Pycnopsyche			-99
Rhyacophila	1		
TUBIFICIDA			
Enchytraeidae		2	1

Aquid Invertebrate Database Bench Sheet Report
Big Cr [0930021], Station #1a, Sample Date: 3/23/2009 11:15:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Tubificidae	8	1	

Aquid Invertebrate Database Bench Sheet Report
Hays Cr [0930025], Station #1, Sample Date: 3/23/2009 6:15:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		2	
AMPHIPODA			
Crangonyx	89	13	63
Hyalella azteca			2
COLEOPTERA			
Helichus basalis	-99		
Stenelmis	7	1	
DIPTERA			
Ablabesmyia		6	7
Ceratopogoninae			1
Chironomidae			2
Chrysops		-99	
Cladotanytarsus		2	
Clinocera	4		
Corynoneura	11	14	33
Cricotopus bicinctus			3
Cricotopus/Orthocladius	32	11	16
Cryptochironomus	1	6	
Diamesa	3		
Dicrotendipes		4	4
Diplocladius	1		
Diptera		1	
Eukiefferiella	83		
Hemerodromia	8		1
Hydrobaenus	7	26	22
Microtendipes	1	1	
Nanocladius		1	
Nilotanypus		1	
Orthocladius (Euorthocladius)	12		
Parametriocnemus	53	3	4
Paratanytarsus	1	8	71
Paratendipes	2	8	
Phaenopsectra	1	11	5
Polypedilum aviceps	54		12
Polypedilum fallax grp	1		1
Polypedilum illinoense grp	2		1
Polypedilum scalaenum grp	2	3	
Prosimulium	47	1	2
Rheocricotopus			3

Aquid Invertebrate Database Bench Sheet Report
Hays Cr [0930025], Station #1, Sample Date: 3/23/2009 6:15:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Rheotanytarsus	2	1	4
Saetheria	2		
Simulium	1		1
Stegopterna	2		
Stempellinella	4	1	
Stictochironomus		2	
Sympotthastia	16		1
Tanytarsus	11	37	5
Thienemanniella	21	5	3
Thienemannimyia grp.	20	5	8
Tipula	1		
Tvetenia	33	1	4
Zavrelimyia		1	2
EPHEMEROPTERA			
Caenis latipennis	11	100	72
Stenacron		1	
Stenonema femoratum	5	25	7
ISOPODA			
Caecidotea	4	1	1
ODONATA			
Cordulegaster			-99
Libellula			-99
PLECOPTERA			
Allocapnia	3	1	
Amphinemura	13		
Haploperla	3	1	
Isoperla	21		
Perlesta	8		
Zealeuctra	1	1	
TRICHOPTERA			
Cheumatopsyche	11		1
Ironoquia			-99
Polycentropus		1	
Rhyacophila	3		
TUBIFICIDA			
Enchytraeidae		2	1
Limnodrilus claparedianus		1	
Tubificidae		1	2

Aquid Invertebrate Database Bench Sheet Report
North Fk Cuivre R [0930024], Station #1, Sample Date: 3/23/2009 4:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina		3	1
AMPHIPODA			
Crangonyx			2
ARHYNCHOBDELLIDA			
Erpobdellidae		-99	-99
COLEOPTERA			
Dytiscidae		1	
Peltodytes			1
Stenelmis	42	5	1
DECAPODA			
Orconectes luteus	-99		
DIPTERA			
Ablabesmyia		25	2
Ceratopogoninae		2	
Chironomidae	3	4	2
Chironomus		2	
Cladotanytarsus		27	
Clinocera	5		1
Corynoneura	2		11
Cricotopus/Orthocladius	116	4	75
Cryptochironomus		7	
Dicrotendipes		3	1
Eukiefferiella	20		1
Glyptotendipes		1	
Hemerodromia	7		
Hydrobaenus	2	10	1
Labrundinia			7
Nanocladius			2
Nilotanypus	3		
Parametriocnemus	11		2
Paratanytarsus	1	11	56
Paratendipes		20	
Phaenopsectra		12	7
Polypedilum aviceps	162	1	38
Polypedilum illinoense grp	6	2	31
Polypedilum scalaenum grp	6	9	
Prosimulium	1		1
Rheocricotopus	1		
Rheotanytarsus	26		24

Aquid Invertebrate Database Bench Sheet Report
North Fk Cuivre R [0930024], Station #1, Sample Date: 3/23/2009 4:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Simulium	36		8
Stempellinella	1		
Stictochironomus		4	
Tabanus	-99		
Tanytarsus	42	76	38
Thienemanniella	8		9
Thienemannimyia grp.	50	9	28
Zavrelimyia		1	
EPHEMEROPTERA			
Acerpenna	42		14
Caenis latipennis	12	42	37
Centroptilum			1
Stenacron	1	1	
Stenonema femoratum	6	7	4
HAPLOTAXIDA			
Haplotaxis		1	
LIMNOPHILA			
Physella			-99
LUMBRICINA			
Lumbricina	-99		
PLECOPTERA			
Amphinemura	1		
Hydroperla crosbyi	-99		1
Isoperla	2		
Perlesta	7		2
TRICHOPTERA			
Cheumatopsyche	57	-99	4
Ironoquia			1
Pycnopsyche			-99
TUBIFICIDA			
Enchytraeidae	1		
Limnodrilus hoffmeisteri		1	1
Tubificidae		5	
VENEROIDA			
Pisidiidae		1	

Aquid Invertebrate Database Bench Sheet Report
South R [0930026], Station #1, Sample Date: 3/24/2009 8:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	1	1	
AMPHIPODA			
Gammarus	61	15	15
ARHYNCHOBDELLIDA			
Erpobdellidae	-99		
COLEOPTERA			
Dubiraphia		1	7
Helichus lithophilus			1
Macronychus glabratus			1
Stenelmis	21	11	6
DECAPODA			
Orconectes luteus	-99	-99	2
Orconectes virilis			-99
DIPTERA			
Ablabesmyia		8	1
Ceratopogoninae	3	6	
Chironomidae	6	3	2
Cladotanytarsus	2	7	
Clinocera	2		
Cnephia	1		
Corynoneura	3	5	5
Cricotopus/Orthocladius	117	13	40
Cryptochironomus	16	17	3
Diamesa	10		
Dicrotendipes		5	2
Diptera	1	1	
Eukiefferiella	18		
Glyptotendipes		1	
Hemerodromia	4		
Hydrobaenus	4	29	6
Microtendipes	1	2	1
Nanocladius			24
Nilotanypus	1	1	
Paracladopelma		1	
Parametriocnemus	25	1	
Paratanytarsus	2	15	54
Paratendipes	3	20	
Phaenopsectra	2	10	3
Polypedilum aviceps	224	2	7

Aquid Invertebrate Database Bench Sheet Report
South R [0930026], Station #1, Sample Date: 3/24/2009 8:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum fallax grp	1		
Polypedilum halterale grp		1	
Polypedilum illinoense grp	6	2	32
Polypedilum scalaenum grp	13	16	
Prosimulium	2		
Rheotanytarsus	19		45
Saetheria	11	9	
Simulium	14		
Sympotthastia	2		
Tabanus	-99		
Tanytarsus	34	75	66
Thienemanniella	9	1	17
Thienemannimyia grp.	32	13	23
Tipula	-99		-99
Zavrelimyia		2	2
EPHEMEROPTERA			
Acerpenna	9		
Caenis latipennis	1	10	23
Caenis punctata			9
Stenacron		5	1
Stenonema femoratum	2	8	1
Tricorythodes	1		2
ISOPODA			
Caecidotea	1		7
LIMNOPHILA			
Menetus			1
LUMBRICINA			
Lumbricina	-99		-99
LUMBRICULIDA			
Lumbriculidae		1	
ODONATA			
Argia			1
Calopteryx			5
Enallagma			6
Gomphus			-99
Hetaerina			1
Libellula			-99
PLECOPTERA			
Amphinemura	1		
Isoperla	2		
Perlesta	2		1

Aquid Invertebrate Database Bench Sheet Report
South R [0930026], Station #1, Sample Date: 3/24/2009 8:40:00 AM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Strophopteryx	1		
TRICHOPTERA			
Cheumatopsyche	16	1	4
Pycnopsyche			-99
Triaenodes			1
TRICLADIDA			
Planariidae			2
TUBIFICIDA			
Enchytraeidae	12	3	
Limnodrilus hoffmeisteri	1		
Tubificidae	12	7	
VENEROIDA			
Pisidiidae			-99

Aquid Invertebrate Database Bench Sheet Report
Sugar Cr [0930023], Station #1, Sample Date: 3/23/2009 2:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	1		
AMPHIPODA			
Crangonyx	32	61	169
Stygobromus	-99	1	
COLEOPTERA			
Agabus			-99
Gyrinus			-99
Heterosternuta			-99
Stenelmis		1	
DECAPODA			
Orconectes virilis		-99	
DIPTERA			
Ablabesmyia		5	
Chironomidae	1		
Cladotanytarsus		3	
Clinocera	1	1	
Corynoneura	8	13	6
Cricotopus/Orthocladius	81	15	4
Cryptochironomus		7	
Dicrotendipes		2	
Diptera		1	
Eukiefferiella	106		
Hemerodromia	2	1	
Hexatoma	-99	1	
Hydrobaenus	2	29	2
Labrundinia		1	
Micropsectra		1	
Microtendipes		4	
Parametriocnemus	5	1	
Paratanytarsus		2	16
Paratendipes		35	3
Phaenopsectra		8	
Polypedilum aviceps	52	3	1
Polypedilum illinoense grp	3	5	
Polypedilum scalaenum grp		4	
Prosimulium	62		1
Pseudochironomus	1		
Rheotanytarsus	2		
Simulium	4		

Aquid Invertebrate Database Bench Sheet Report
Sugar Cr [0930023], Station #1, Sample Date: 3/23/2009 2:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Stempellinella		2	
Tanytarsus	4	80	10
Thienemanniella	16	3	1
Thienemannimyia grp.	10	2	2
Tvetenia	1		
Zavrelimyia		4	
EPHEMEROPTERA			
Acerpenna	2		
Caenis latipennis		3	1
Stenonema femoratum	1	11	-99
HEMIPTERA			
Belostoma			1
Gerridae			2
ISOPODA			
Caecidotea	177	31	38
LIMNOPHILA			
Physella	-99		5
PLECOPTERA			
Allocapnia		2	2
Amphinemura	21		
Clioperla clio	1		
Haploperla	69	4	1
Isoperla	48		
Perlesta	1		
Perlinella drymo			-99
Prostoia	4		
Zealeuctra		1	
TRICHOPTERA			
Agapetus			1
Cheumatopsyche	1	1	1
Chimarra	1		
Hydroptilidae	2		
Ironoquia			-99
Limnephilidae			2
Pycnopsyche			-99
Rhyacophila	3		-99
TRICLADIDA			
Planariidae	4		
TUBIFICIDA			
Enchytraeidae		3	

Aquid Invertebrate Database Bench Sheet Report
Sugar Cr [0930023], Station #1, Sample Date: 3/23/2009 2:00:00 PM
CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Tubificidae	3		

Appendix C

Dardenne Creek Study Plan

Missouri Department of Natural Resources
Dardenne Creek Biological Assessment Study Plan
St. Charles County, Missouri
August 15, 2008

Introduction

Dardenne Creek originates in Warren County and flows generally east through a rural St. Charles County watershed, which is interspersed with housing subdivisions. The creek downstream of Highway 40-61 is more heavily impacted, including reaches that appear to have been channelized and serve as the receiving system for urban runoff. The middle reach, where land use is changing from rural to suburban, has been the focus of past Department of Natural Resources studies. The department's Water Protection Program (**WPP**) first requested a biological assessment of Dardenne Creek be conducted in 2002 to address potential water quality concerns related to increasing levels of development in the watershed. Based on a portion of that study's findings—specifically, that the benthic substrate of the downstream study reach was significantly covered with fine sediment—the department added Dardenne Creek to the 2002 303(d) List of Impaired Waters for unknown pollutants originating from urban and rural nonpoint source pollution.

The 2002 study included macroinvertebrate community, benthic sediment, and water quality analyses at six stations on Dardenne Creek and two stations on North Fork Cuivre River (a local control stream). Water quality analysis included a standard suite of chemistry parameters (described below) as well as testing for fecal coliform. Biological metrics tended to increase from upstream to downstream with the exception of Station 4 near the confluence of Little Dardenne Creek (please see Appendix A, map 1). One recommendation of the 2002 study was to collect additional samples at a later date to determine whether the seemingly anomalous decline observed at this station was due to some factor associated with the Little Dardenne Creek subwatershed.

In September 2005 a second biological assessment study was initiated to address recommendations in the 2002 report. This study repeated macroinvertebrate and water quality sampling at Station 3 and Station 4; in addition Station 4.1 was established immediately upstream of the Little Dardenne Creek confluence as well as a station on Little Dardenne Creek itself. Water quality analyses did not indicate any notable differences in Dardenne Creek upstream versus downstream of the confluence, nor was water quality in Little Dardenne Creek sufficiently different to suggest it was the cause of the macroinvertebrate community aberration observed in the 2002 study. The biological component of the follow-up study was judged to be inconclusive, however, due to low water levels during the fall 2005 sample season as well as during the winter months preceding spring 2006 sampling. A recommendation was made in the 2005/2006 study to conduct yet another biological assessment at some point in the future following at least two years of near-average precipitation.

Objectives
This proposed study will essentially repeat the 2002 study with the exception that the fecal coliform portion will be eliminated. Macroinvertebrate community composition, water quality, and benthic sediment coverage will be assessed at the same six stations on Dardenne Creek plus the additional station upstream of Little Dardenne Creek added in 2005/2006, pending landowner permission. The following objectives will be addressed to determine if: 1) Dardenne Creek supports its beneficial use designation of supporting aquatic life based on biological criteria calculated from reference stream macroinvertebrate data in the Central Plains/Cuivre/Salt Ecological Drainage Unit; 2) aquatic life in Dardenne Creek is impaired relative to local control streams; 3) Dardenne Creek is impaired due to nutrification; and 4) benthic sediment coverage is greater in Dardenne Creek than in local control streams.

Study Area
The study area includes approximately 15 miles of Dardenne Creek located between the August A. Busch Conservation Area upstream to the State Road Z Bridge crossing, north of New Melle. The test stations listed below were used for previous biological assessment studies. We will attempt to sample these sites for the current study. The 2002 biological assessment was conducted as part of a joint project with the Missouri Department of Conservation (**MDC**). MDC personnel used Global Information Systems (**GIS**) software (e.g. ArcView®) to choose Dardenne Creek stream reaches in a randomly stratified manner to sample for fish; we used these same stations for our purposes. Little Dardenne Creek Station 1 and Dardenne Creek Station 4.1 were added in 2005 for the second study; however Little Dardenne Creek will not be included in this study.

A total of four local control stations will be used to assist in the evaluation of the Dardenne Creek stations (Appendix A, map 2). Each of these local control stations include streams which are rated Class "C" in Missouri's Water Quality Standards, and will be used to help assess conditions among Dardenne Creek stations that are within the Class "C" reach (i.e. including and upstream of Dardenne Creek Station 2). Control streams were selected in a manner similar to reference streams and have no significant influence from permitted discharges.

In addition, South River, a biological criteria reference stream will be used for this study. Macroinvertebrate, water quality, and sediment cover estimation samples will be collected at the historic sample sites (see below). We will also attempt to establish multiple stations along a longitudinal gradient within the South River to conduct sediment sampling. As many as four additional stations will be sampled, pending accessibility, to address possible longitudinal differences in sediment distribution. South River station descriptions and coordinates will be added after field reconnaissance and landowner contacts have been made.

<u>Test Stations</u>
Dardenne Creek Station 1 (no legal description) is located north of Lake 33 (also known as Kraut Run Lake) in the August A. Busch Conservation Area in St. Charles County.

Universal Transverse Mercator (**UTM**) coordinates collected at the upstream boundary of the sample reach are UTMN 4290156.9, UTME 694110.2

Dardenne Creek Station 2 (NE¼ sec. 21, T. 46 N., R. 2 E.) is located downstream of the State Road DD bridge in St. Charles County. UTM coordinates, measured approximately 300 yards upstream of the Busch Conservation Area property boundary, are UTMN 4289579.6, UTME 691487.6.

Dardenne Creek Station 3 (Survey 418, T. 46 N., R. 2 E.) is located downstream of the Hopewell Road bridge in St. Charles County. UTM coordinates were taken at the first riffle downstream from a Missouri Department of Conservation fish sampling station marker (UTMN 4290142.8, UTME 689710.9).

Dardenne Creek Station 4 (Survey 891, T. 46 N., R. 2 E.) is located upstream of the Hopewell Road bridge in St. Charles County. UTM coordinates were taken at the MDC fish sampling station marker (UTMN 4290686.4, UTME 688210.1).

Dardenne Creek Station 4.1 (Survey 891, T. 46 N., R. 2 E.) is located upstream of the Little Dardenne Creek confluence in St. Charles County. UTM coordinates at the downstream terminus of the sample reach are UTMN 4290702.8, UTME 687836.8.

Dardenne Creek Station 5 (NW¼ sec. 24 and NE¼ sec. 23, Survey 1807, T. 46 N., R. 1 E.) is located downstream of the State Road Z bridge in St. Charles County. UTM coordinates were taken at the MDC fish sampling station marker (UTMN 4289409.6, UTME 684966.4).

Dardenne Creek Station 6 (E½ sec. 22, T. 46 N., R 1 E.) is located upstream of the State Road Z bridge in St. Charles County. UTM coordinates were taken at the MDC fish sampling station marker (UTMN 4289064.4, UTME 683615.7).

<u>Biological Reference Station</u>
South River Station 1 (NE¼ sec. 31, T. 58 N., R. 5 W.) is a reference stream located upstream of the County Road 403 bridge in Marion County. UTM coordinates at the downstream terminus of the sample reach are UTMN 4404786.4, UTME 628341.9.

<u>Local Control Stations</u>
North Fork Cuivre River Station 1 (Section Line 13/14, T. 51 N., R. 3 W.) is a control stream located downstream of the County Road 325 bridge in Pike County. UTM coordinates were taken immediately downstream of the bridge (UTMN 4339803.1, UTME 655188.9).

Big Creek Station 1 (NW¼ sec. 34, T. 48 N., R. 2 W.) is a control stream located upstream of the North Church Rock Road bridge in Warren County. UTM coordinates at the downstream terminus of the sample reach are UTMN 4305582**,** UTME 662317.

Hays Creek Station 1 (NW¼ sec. 29, T. 54 N., R 5 W.) is a control stream located upstream of the Bridgewater Lane bridge in Ralls County. UTM coordinates at the downstream terminus of the sample reach are UTMN 4366398, UTME 629917.

Sugar Creek Station 1 (NW¼ sec. 31, T. 50 N., R. 1 E.) is a control stream located upstream of the State Road KK within Cuivre River State Park in Lincoln County. UTM coordinates at the downstream terminus of the sample reach are UTMN 4325175, UTME 677738.

Null Hypotheses

1) The macroinvertebrate community will not differ longitudinally among Dardenne Creek study sites.

2) The Dardenne Creek macroinvertebrate community will not differ from that of reference streams within the Central Plains/Cuivre/Salt Ecological Drainage Unit.

3) The Dardenne Creek macroinvertebrate community will not differ from that of local control streams.

4) Water quality and nutrient parameters will not differ longitudinally among Dardenne Creek study sites.

5) Dardenne Creek benthic sediment deposits will not be statistically different than biological reference or local control streams.

Macroinvertebrate Sample Collection

Each macroinvertebrate station will consist of a length approximately 20 times the average stream width and will contain at least two riffle/pool complexes. Samples will be collected during fall 2008 (mid September to mid October) and spring 2009 (mid March to mid April).

Macroinvertebrates will be sampled according to the methods described in the department’s Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP**). Dardenne Creek will be sampled as a “riffle/pool” dominant stream with samples being collected from flowing water over coarse substrate, depositional (non-flow), and rootmat habitats. Each macroinvertebrate sample will be a composite of six subsamples within each habitat.

Laboratory processing methods will be conducted as outlined in the SMSBPP. Each sample will be processed under 10x magnification to remove a habitat-specific target number of individuals from debris. Individuals will be identified to standard taxonomic levels according to MDNR-ESP-209 (Taxonomic Levels for Macroinvertebrate Identification) and enumerated.

Water Quality Sample Collection
Water quality samples will be collected concurrently with macroinvertebrate samples during each of the two sample seasons at all sites. Samples will be collected per the methods described in the department's standard operating procedures (**SOP**) MDNR-FSS-001 (Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Considerations) and MDNR-ESP-002 (Field Sheet and Chain-of-Custody Record). All water samples will be analyzed for ammonia-nitrogen, nitrite+nitrate-nitrogen, total nitrogen, total phosphorus, chloride, and turbidity. In addition the following field parameters will be measured: temperature [MDNR-FSS-101 (Field Measurement of Water Temperature)]; dissolved oxygen [MDNR-WQMS-103 (Sample Collection and Field Analysis of Dissolved Oxygen Using a Membrane Electrode Meter)]; conductivity [MDNR-FSS-102 (Field Analysis for Specific Conductance)]; turbidity [MDNR-WQMS-012 (Analysis of Turbidity Using the Hach 2100P Portable Turbidimeter)]; and pH [MDNR-FSS-100 (Field Analysis of Water Samples for pH). Stream velocity also will be measured at the time of sample collection using a Marsh-McBirney Flo-Mate™ Model 2000 flow meter. Discharge will be calculated in cubic feet per second using the method in MDNR-WQMS-113 (Flow Measurement in Open Channels). All field meters used to collect water quality parameters are maintained in accordance with MDNR-ESP-213 (Quality Control Procedures for Checking Water Quality Field Instruments).

Data Recording and Analysis
Macroinvertebrate and water quality data will be entered into a Microsoft Access database as described in MDNR-WQMS-214 (Quality Control Procedures for Data Processing). Below is a summary of the primary metrics used in numerical assessment of the macroinvertebrate community:

- <u>Taxa Richness (TR)</u>
  Reflects the health of the community through a measurement of the number of taxa present. In general, the total number of taxa increases with improving water quality, habitat diversity, and habitat suitability. Taxa Richness is calculated by counting all taxa from the subsampling effort.

- <u>Total Number of Taxa within the Taxonomic Orders Ephemeroptera, Plecoptera, and Trichoptera (EPT Taxa)</u>
  This value summarizes taxa richness within the insect taxonomic orders that are generally considered to be pollution sensitive. The EPT Taxa index generally increases with higher water quality.

- <u>Biotic Index (BI)</u>
  This value is a means of describing organic pollution tolerance of individual taxa within the macroinvertebrate communities expressed as a single value between 0 and 10, with 0 being the most sensitive and 10 being the most tolerant.

- <u>Shannon Diversity Index (SDI)</u>
  This index is a measure of community composition which includes both richness and evenness. It is assumed that a more diverse community is a healthy community. Diversity increases as the number of taxa increases and as the distribution of individuals among those taxa is more evenly distributed.

Using the values calculated from the above metrics, a Stream Condition Index (**SCI**) score will be assigned to the macroinvertebrate data for each sample station based on biological criteria derived from reference streams in the Central Plains/Cuivre/Salt EDU. The SCI scores are divided into three categories. Study reaches that score from 16-20 are considered fully biologically supporting, scores from 10-14 are considered partially biologically supporting, and scores of 4-8 are considered non-biologically supporting of the designated use. In other words, failing to exceed the numeric threshold necessary for the attainment of the water body's beneficial use as specified in Missouri's Water Quality Standards.

Benthic Sediment Measurement
Because the elevated benthic sediment coverage we observed in the 2002 study was a key component in the listing of Dardenne Creek, we will repeat this aspect of the investigation using the stratified random sampling design and sampling methods described in the draft Standard Operating Procedures (**SOP**) in Appendix B. Although the methods used to measure benthic sediment coverage in 2002 study have been widely used and are accepted within the scientific community, we will supplement our methods for this study to address the issue of "subjectivity" brought forth in legal affidavits regarding the listing of Dardenne Creek.

In addition to using the quadrat described in the draft SOP, a 60 cm X 60 cm United States Forest Service Pebble Count Sampling Frame (Appendix C) will be used to visually estimate sediment. A visual estimate will be made using the quadrat as described in the draft SOP; following this estimate, the quadrat will be removed from the substrate and replaced with the sampling frame. This pebble count frame features an adjustable grid of elastic bands that can subdivide the sample area. As with the draft SOP, two investigators will be used to estimate sediment coverage in a stratified random study sampling design. However, with the pebble count frame the particle size beneath each of the 25 intersections of the bands will be evaluated. The number of intersections that occur over benthic sediment <2.0 mm in diameter will be recorded and converted to percent coverage of fine sediment. This percent coverage will be analyzed per the methods described in the draft SOP (Appendix B) to determine whether a statistically significant difference ($p < 0.05$) exists among Dardenne Creek stations compared to one another as well as to local control or biological criteria reference sites.

Data Reporting

Results of the study will be summarized, interpreted in report format, delivered to the Biological Assessment Quality Assurance Project Planning project officer, and posted on the department's internet web site.

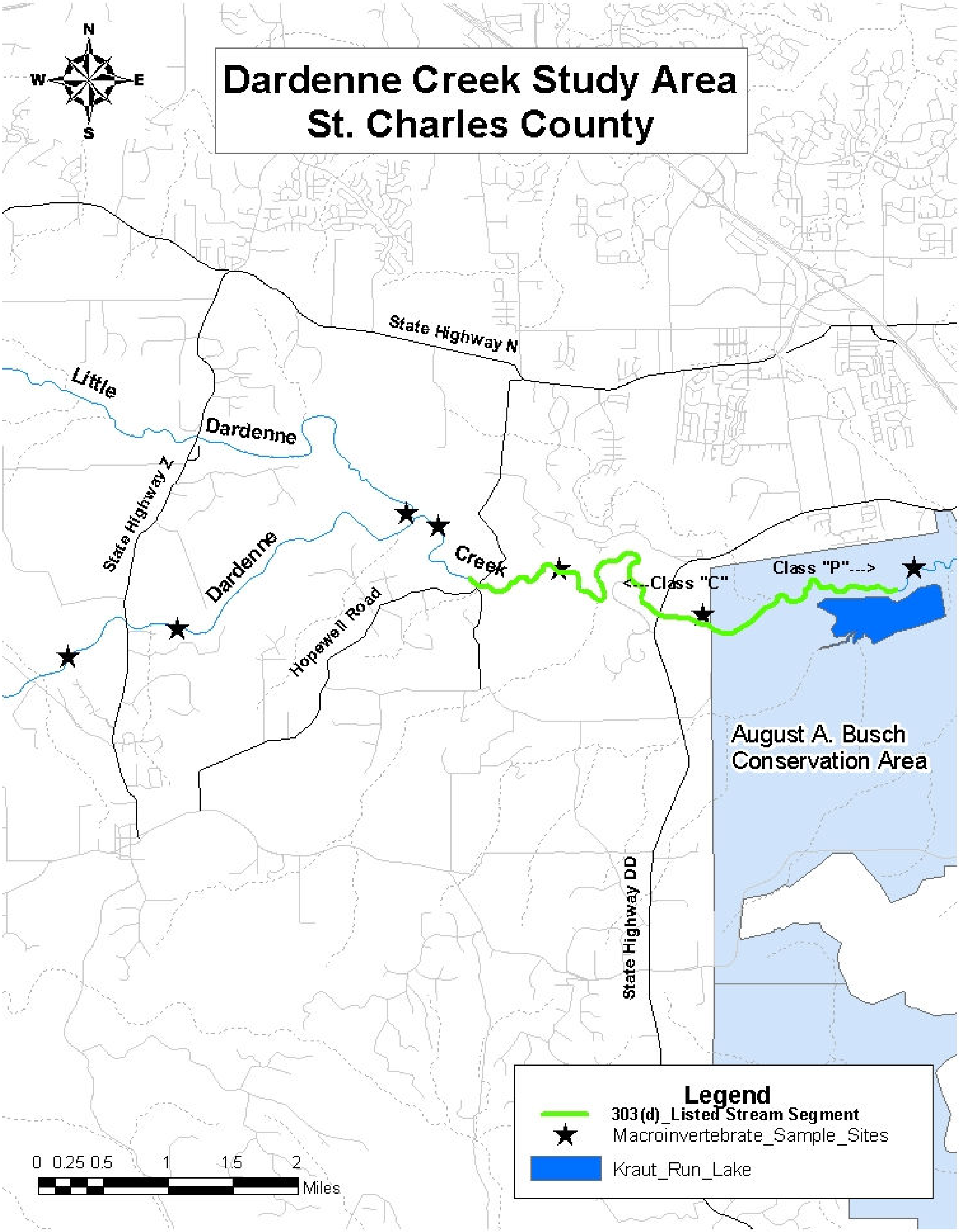
Appendix A

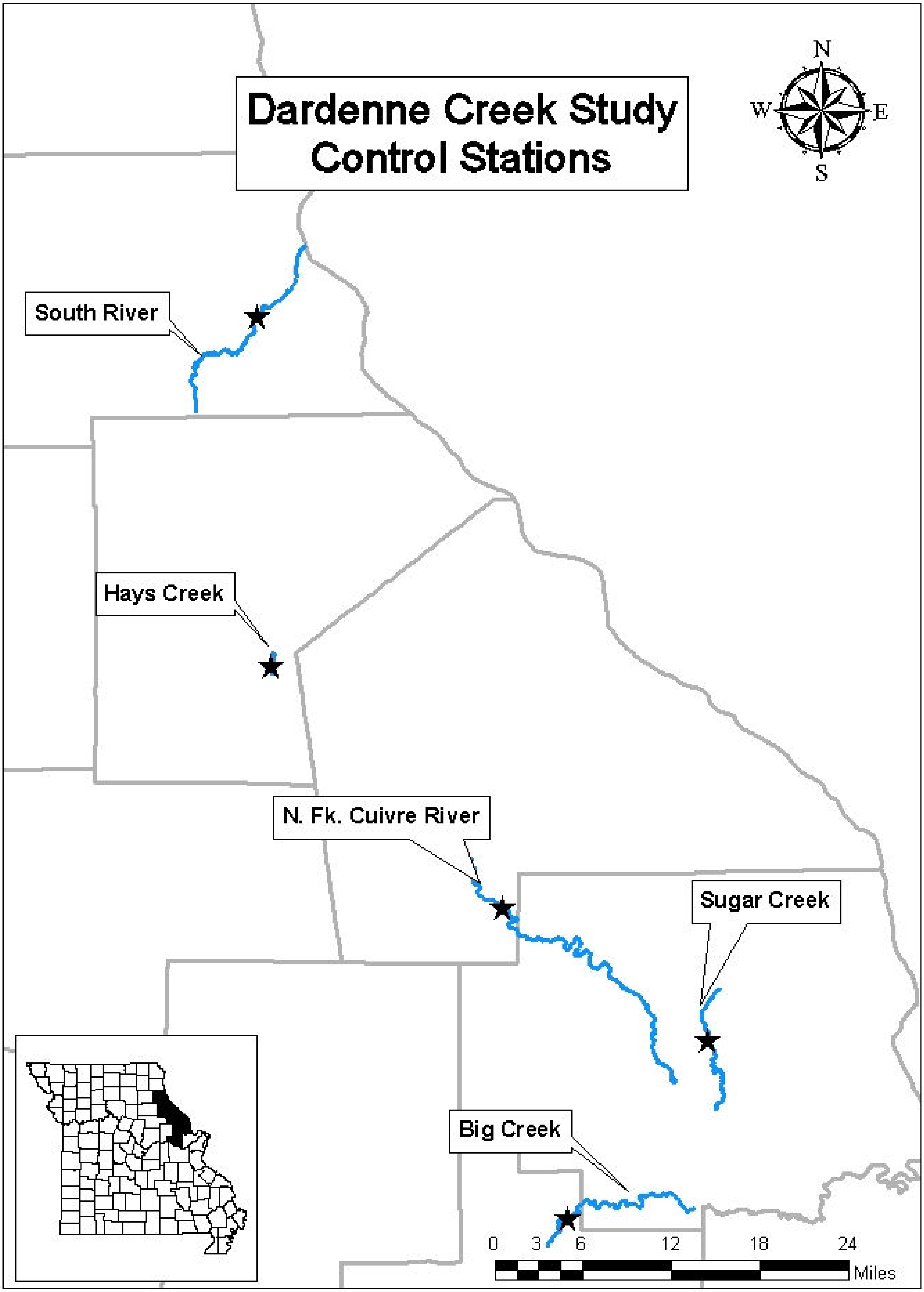
Maps

Sample Stations Located on Dardenne Creek
Central Plains/Cuivre/Salt EDU

&

Dardenne Creek Control Sites


Dardenne Creek Study Area
St. Charles County
N
S
E
W
State Highway N
Little
Dardenne
State Highway Z
Dardenne
Creek
Hopewell Road
<---Class "C"
Class "P"--->
August A. Busch
Conservation Area
State Highway DD
Legend
303(d)_Listed Stream Segment
Macroinvertebrate_Sample_Sites
Kraut_Run_Lake
0 0.25 0.5 1 1.5 2
Miles



Dardenne Creek Study
Control Stations
N
W
E
S
South River
Hays Creek
N. Fk. Cuivre River
Sugar Creek
Big Creek
0
3
6
12
18
24
Miles

Appendix B

Draft Standard Operating Procedure

Percent Estimation of Fine Sediment Substrate in Streams

MISSOURI DEPARTMENT OF NATURAL RESOURCES
FIELD SERVICES DIVISION
ENVIRONMENTAL SERVICES PROGRAM
Standard Operating Procedures

SOP #: MDNR-ESP-115 EFFECTIVE DATE: ____________

SOP TITLE: Percent Estimation of Fine Sediment Substrate in Streams

WRITTEN BY: Kenneth B. Lister, Water Quality Biologist, Water Quality Monitoring Section, ESP

APPROVED BY: ____________

DRAFT

SUMMARY OF REVISIONS: Not applicable. This is a new document.

APPLICABILITY: The procedures outlined in this document apply to all ESP personnel who perform biological assessments, wasteload allocations and other special stream studies.

DISTRIBUTION: MDNR Intranet
ESP, SOP Coordinator

RECERTIFICATION RECORD:

Date Reviewed				
Initials				

1.0 BACKGROUND, SCOPE AND APPLICATION

1.1 The U.S. Environmental Protection Agency listed sediment as the number one source for stream impairment (Clean Water Act Section 303(d); USEPA 2000). Fine sediments clog interstitial voids between the larger stream substrate particles, and can have destructive effects on invertebrate and fish communities (Chutter 1969; Murphy et al. 1981; Berkman and Rabeni 1987; Smale et al. 1995). Zweig and Rabeni (2001) found that the presence and absence of certain aquatic invertebrate taxa was related to the amount of fine sediment visually observed in the stream substrate. This Standard Operating Procedure (SOP) is one method of visually estimating the percentage of fine sediment on the stream substrate in an area where fine sediment is temporarily stored. Sediment estimations at control stations may then be compared to potentially impaired stream segments.

1.2 This SOP is designed to provide guidance for personnel to consistently and accurately visually estimate the relative percentage of fine sediment on the stream substrate per stream reach. The amount of fine sediment may be statistically tested for significant differences between stream reaches or what are called stations. The method can be used by stream ecologists, trained stream volunteers, or other personnel with a general understanding of scientific methods.

1.3 This procedure should only be used in wadeable streams that are riffle/pool dominant streams, as defined in the Semi-Quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP; MDNR 2003c). Riffle/pool dominant streams are usually Ozark streams that have a characteristic rock substrate, as opposed to clay, mud, or sand substrates of Prairie streams. This method may not be applicable to sediment concerns in glide/pool dominant streams of northern and western Missouri streams.

1.4 Examples of how this method was used can be found in MDNR, WQMS reports for Flat River (Creek; MDNR 2002); Bull Creek, Taney County (MDNR 2003a); and Upper Big River, Washington County (MDNR 2003b).

2.0 SUMMARY OF METHOD

2.1 This method of visually estimating the relative percentage of fine sediments (<2.0 millimeters, mm; approximately 1/16th of an inch; Modified Wentworth Scale by Cummins 1962) is consistent and is statistically testable between stream reaches, or stations.

2.2 The study areas are located in the stream where fine sediments are temporarily stored. The study area, which is called a “grid”, is mostly virtual and requires very little equipment or time to set up. The grid contains a large number of potential sample areas, called “quadrats”. A quadrat is a metal square approximately 10 inches by 10 inches ($0.25m^2$) square and made of 1/2 inch angle iron. Three grids are used per stream reach or station.

2.3 Two observers visually estimate the percentage of fine sediment per quadrat and the estimates are recorded if they are within a 10 percent margin of error. A mean per quadrat is entered into a spreadsheet or database for analyses.

2.4 Statistical tests, such as Analysis of Variance on Ranks (Kruskal-Wallis, ANOVA on Ranks), illustrate if differences exist between stations, and multiple comparison procedures, such as Tukey's or Dunn's tests can identify which stations have significantly different amounts of fine sediment.

3.0 DEFINITIONS

3.1 Station: A "Stream reach" as defined in SMSBPP (MDNR 2003c); The length of a station is 20 times average stream width. A station should include at least two riffle sequences.

3.3 Grid: A virtual sample area composed of six contiguous transects, which contain numerous potential sample sites or quadrats (Appendix A).

3.4 Transect: A 12 inch-wide band that crosses the stream (T; Appendix A). Six transects make up a grid.

3.5 Quadrat: A metal square ($0.25\ m^2$; 10"x 10"; Appendix A) that is used to outline the area where the percentage of benthic fine sediment is visually estimated.

4.0 HEALTH AND SAFETY REQUIREMENTS

4.1 Personnel should wear waders and latex gloves for protection from contaminated water.

5.0 PERSONNEL QUALIFICATIONS

5.1 Personnel should be trained in proper placement of grids and estimation of fine sediment particles.

5.2 Personnel should have a general understanding of statistical methods in determining significant differences between control and test groups (stations).

6.0 SUPPLIES AND EQUIPMENT

6.1 The following is list of equipment necessary to conduct the fine sediment estimation procedure:

- Fine sediment sampling datasheets (one per station; Appendix B)

- 1- Quadrat (see definitions)
- 100 foot fiberglass measuring tape
- 16’ x 1” Steel retractable measuring tape (one per investigator)
- 2- Metal stakes (rerod) approximately 30” long.
- Hammer
- Marsh-McBirney Flowmeter and top adjusting flow rod
- Global Positioning System (GPS) Unit
- Waders
- Latex gloves

7.0 PROCEDURE

7.1 Sampling should be conducted at base flow.

7.2 In order to ensure sampling method uniformity, grids are located at the lower margins of riffles, and upper margins of pool habitat.

7.3 The (virtual) grid is composed of subunits called transects, and quadrats (see 3.0 Definitions; Appendix A).

7.4 Use a Marsh-McBirney flowmeter and a top adjustable wading rod to find a suitable location to place a grid. Downstream from a riffle, measure general water velocity to identify an area where the velocity is ≤0.5 feet per second (fps). The depth of the water in a potential grid should not exceed 2.5 feet. An area that meets these criteria is part of the virtual grid.

7.5 Anchor a 100’ fiberglass tape measure across the stream above the surface of the water. The suitable location must have general unidirectional flow, which excludes eddies, sharp bends, near-bank vegetation, downstream of logs, boulders or other large obstructions. Measure the width in the stream excluding these obstructions. This is the useable width of the grid. A GPS location may be recorded on the datasheet at this point.

7.6 Select a random number from a random number sheet (or other method) which is within the useable width, and record this value in the random number box located on the datasheet (Appendix B). This random number equates to a number of feet on the fiberglass tape measure where the quadrat will be placed from the edge of the useable grid.

7.7 While standing downstream of the grid and facing upstream, find the random distance (random number) on the fiberglass tape.

7.8 Align the downstream edge of the quadrat along the upstream edge of the fiberglass tape, and so that it includes all increments of the random distance possible. Carefully, submerge the quadrat and place it directly on the substrate.

7.9 Two observers visually estimate the percentage of the fine sediment sized particles (<2mm, or approximately 1/16"; Modified Wentworth Scale in Cummins 1962) within the quadrat. If the two estimates are within a 10 percent margin of error, record them on the datasheet. If estimates are more than ten percent from each other, observers must repeat the estimation process until they are within the acceptable margin of error.

7.10 A description of the dominant size class of fine sediment (sand/silt) may be recorded for each quadrat. Comments may also be made for each quadrat or grid, regarding the depth of the sediment or drawings; etc.

7.11 For transect 2, select a random number and find the random distance on the fiberglass tape, as was done in 7.6 and 7.7. Expose 12" of the metal retractable tape. Hold the metal tape perpendicular to the fiberglass tape measure with the 12" mark on the random distance. Place the quadrat directly on the substrate, including all increments of the random distance, and upstream of end of the retractable metal tape. Repeat steps 7.9-7.10 for the second transect.

7.12 For transect 3, select a random number and find the random distance on the fiberglass tape, as was done in 7.6 and 7.7. Expose 24" of the metal retractable tape. Hold the metal tape perpendicular to the fiberglass tape measure with the 24" mark on the random distance. Place the quadrat directly on the substrate, including all increments of the random distance, and upstream of the end of the retractable tape. Repeat steps 7.9-7.10 for the third transect.

7.13 Repeat 7.6- 7.10 increasing the distance upstream from the fiberglass tape by adding 12" to the metal retractable tape for each additional transect, until all six transects have been sampled in the grid.

7.14 Locate another riffle within the station and repeat steps 7.4 -7.5 to construct an additional grid. Conduct 7.6-7.14 to record estimates of fine sediments within the station. A total of three virtual grids should be constructed for each station.

7.15 The datasheet allows for recording two quadrats per transect if necessary. Two quadrats per transect will be necessary if stream is wider than 100 feet, if three riffles are not found within a station, or if QC is being conducted (see Section 12.3 QC/QA). If this is necessary, select two random numbers for placing two quadrats in each transect

7.16 An arithmetic mean of these two estimates per quadrat is recorded and used for analyses.

8.0 SAMPLING CONSIDERATIONS

8.1 Fine sediment decreases visibility when it becomes suspended. Walk only in downstream areas of the grid and in transects where estimates have been already been made. Do not walk immediately upstream of the grid. Take estimates as quickly as possible, or allow fine sediment to settle after placing the quadrat.

8.2 Sampling should be timed to avoid excessive benthic algae or aquatic plant growth that may hinder visual observations.

8.3 Sampling should be done at base flow.

8.4 Glare on the water surface can make visual observations difficult. Polarized glasses or other object (clipboard) can decrease the glare.

9.0 DATA ACQUISITION, CALCULATIONS, AND DATA REDUCTION

9.1 Calculate the arithmetic mean of two observers = $\frac{\text{Observer 1 + Observer 2}}{2}$

9.2 Enter the mean for each quadrat into Microsoft Excel spreadsheet, using each station as major headings, and fine sediment data means in a data column. This can be used to generate figures, with stations on the x-axis and percent fine sediment on the y-axis.

9.3 The data may then be exported into a Microsoft Access database program, such as MDNR/ESP's Fine Sediment Substrate database.

9.4 Export data from Excel to SigmaStat (Version 2.0) for rank comparisons of fine sediment percentage estimates between stations.

9.5 Use Kruskal-Wallis, One-way Analysis of Variance (ANOVA) on ranks. This is a qualitative rank test that determines if there are differences between stations. It is not dependent on Normality or Equal Variances for accuracy, and it is a more conservative indicator of significant differences. Transformations of the percentages are also not necessary with the rank tests.

9.6 Use Tukey's Test, an All Pairwise Multiple Comparison Procedure if there are an equal number of observations (n) per station to identify which stations are different.

9.7 Use Dunn's Test to identify which stations are different if there are an unequal number of observations (n) per stations. Dunn's can also test the control station versus all of the test stations, if desired.

9.8 A significant difference equates to $p<0.05$

10.0 COMPUTER SOFTWARE

10.1 Microsoft Excel spreadsheet

10.2 SigmaStat (Version 2.0)

10.3 Microsoft Access Database Program (optional)

11.0 DATA MANAGEMENT AND RECORDS MANAGEMENT

11.1 Data may be maintained by WQMS in the Fine Sediment Database (MDNR, ESP, Water Quality Monitoring Section).

12.0 QUALITY CONTROL AND QUALITY ASSURRANCE

12.1 Two observers give unbiased and repeatable estimates.

12.2 Estimates must be within a 10 percent margin of error or the observation is rejected. The observers repeat the estimate process until both are within the margin of error.

12.3 Quality Control may consist of sampling two quadrats per transect at one grid in ten grids, and examining the variance between the two sets of data.

13.0 REFERENCES

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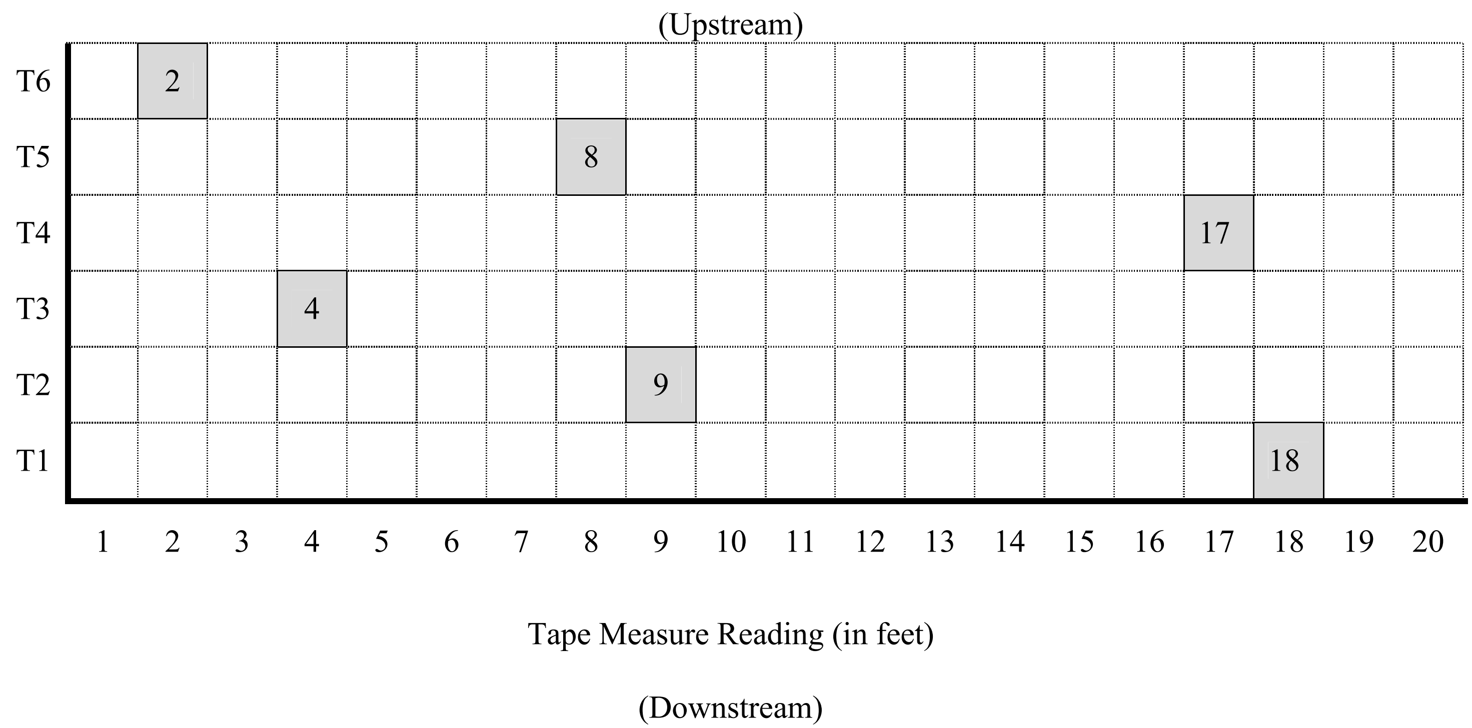
Virtual grid of transects (T), and quadrats (in gray, numbered) for estimating percent fine sediment.
Example: stream 20' wide; quadrats placed by selecting random numbers (e.g. 18, 9, 4, 17, 8, 2).

RIFFLE



POOL

DATASHEET- SEDIMENT PERCENTAGE ESTIMATION

Stream Name:__________________________ Station:______ County:_________________________ Date:________

Observer:______________________________
Observer:______________________________

Grid 1 Location Latitude:________________________Longitude:______________________Waypoint#:__Sats:__Points:_______
Description:____
Width:___________________Velocity:________________________Depth:___________________

TRANSECT	1	2	3	4	5	6
Random Number (quad)						
Estimates (Percent)						
Mean						
Dom. Class Sed. (circle)	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt
TRANSECT (optional)	1A	2A	3A	4A	5A	6A
Random Number (quad)						
Estimates (Percent)						
Mean						
Dom.Class Sed. (circle)	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt

COMMENTS:

Grid 2 Location Latitude:_______________________Longitude:_____________________Waypoint#:___Sats:__Points:_______

Description:____

Width:___________________Velocity:_______________________Depth:___________________

TRANSECT	1	2	3	4	5	6
Random Number (quad)						
Estimates (Percent)						
Mean						
Dom. Class Sed. (circle)	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt
TRANSECT (optional)	1A	2A	3A	4A	5A	6A
Random Number (quad)						
Estimates (Percent)						
Mean						
Dom. Class Sed. (circle)	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt

COMMENTS:

Grid 3 Location Latitude:_______________________Longitude:_____________________Waypoint#:___Sats:__Points:_______

Description:____

Width:___________________Velocity:_______________________Depth:___________________

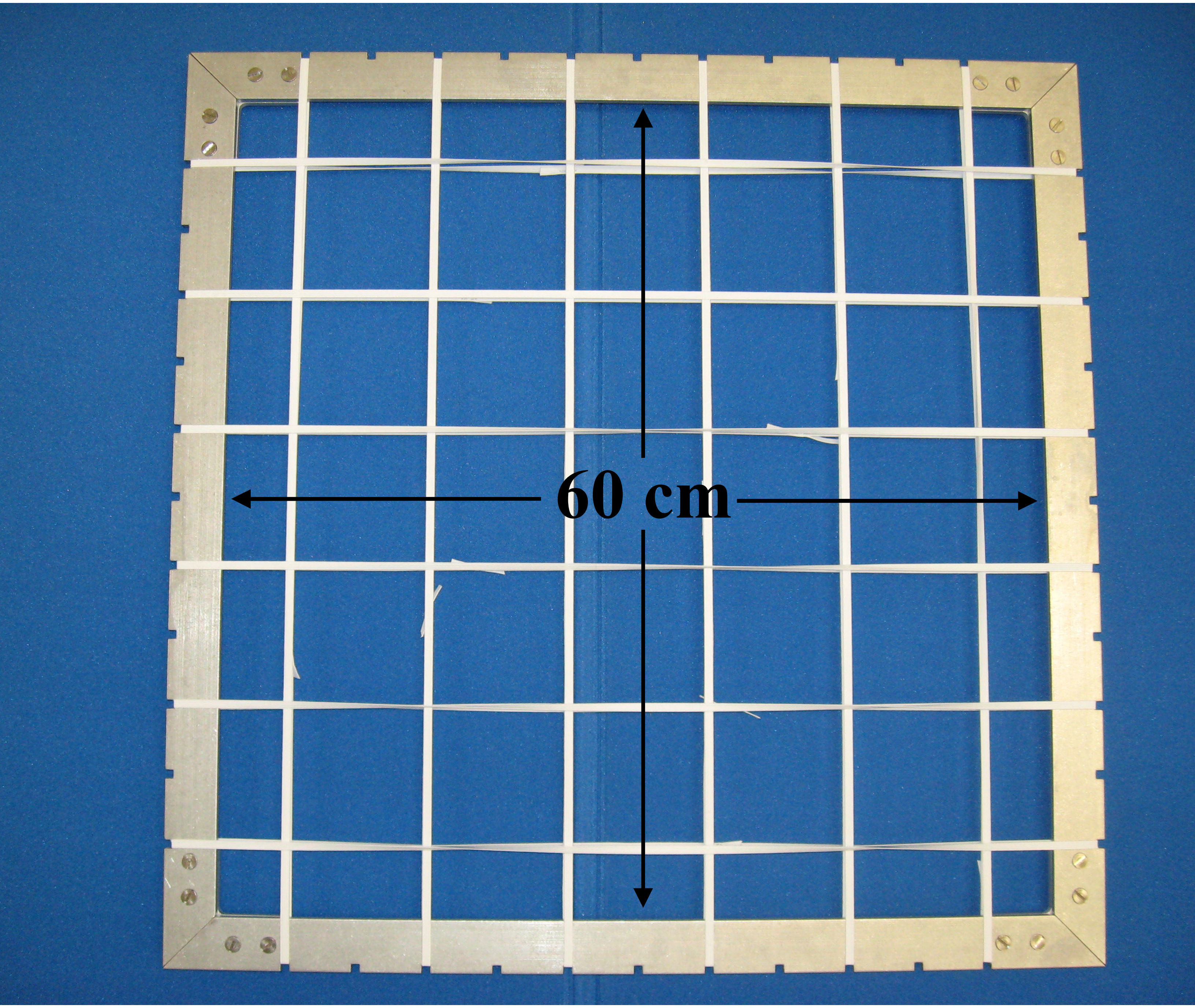
TRANSECT	1	2	3	4	5	6
Random Number (quad)						
Estimates (Percent)						
Mean						
Dom. Class Sed. (circle)	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt
TRANSECT (optional)	1A	2A	3A	4A	5A	6A
Random Number (quad)						
Estimates (Percent)						
Mean						
Dom. Class Sed. (circle)	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt	Sand/silt

COMMENTS:

Appendix C

Photograph

United States Forest Service Pebble Count Sampling Frame


60 cm

Appendix D

Statistical Analyses

Mann-Whitney Rank Sum Test Results

t-test Friday, February 06, 2009, 9:00:03 AM

Data source: All Dardenne Stations versus All Control Stations--Visual Estimation Method

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Friday, February 06, 2009, 9:00:03 AM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Dardenne Visual	129	3	80.000	10.000	100.000
Controls Visual	147	3	17.500	0.000	76.250

Mann-Whitney U Statistic= 6332.000

T = 19813.000 n(small)= 126 n(big)= 144 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

t-test Friday, February 06, 2009, 9:44:32 AM

Data source: All Dardenne Stations versus All Control Stations--Pebble Count Frame Method
Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Friday, February 06, 2009, 9:44:32 AM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column C	126	0	60.000	4.000	100.000
Column G	144	0	8.000	0.000	40.000

Mann-Whitney U Statistic= 5722.500

T = 20422.500 n(small)= 126 n(big)= 144 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

t-test Monday, April 20, 2009, 2:50:39 PM

Data source: Dardenne Creek #1 versus All Controls--Visual Estimation Method

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 2:50:39 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	100.000	92.500	100.000
Column F	144	0	17.500	0.000	76.250

Mann-Whitney U Statistic= 444.000

T = 2319.000 n(small)= 18 n(big)= 144 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

t-test Monday, April 20, 2009, 2:56:22 PM

Data source: Dardenne Creek # 1 versus All Controls--Pebble Count Frame Method

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 2:56:22 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	100.000	92.000	100.000
Column G	144	0	8.000	0.000	40.000

Mann-Whitney U Statistic= 261.000

T = 2502.000 n(small)= 18 n(big)= 144 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

t-test Monday, April 20, 2009, 2:59:05 PM

Data source: Dardenne Creek #2 versus All Controls--Visual Estimation Method

Normality Test: Failed ($P < 0.050$)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 2:59:05 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	83.750	12.500	100.000
Column F	144	0	17.500	0.000	76.250

Mann-Whitney U Statistic= 797.500

T = 1965.500 n(small)= 18 n(big)= 144 ($P = 0.007$)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference ($P = 0.007$)

t-test Monday, April 20, 2009, 3:01:00 PM

Data source: Dardenne Creek #2 vs All Controls--Pebble Count Frame Method

Normality Test: Failed ($P < 0.050$)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 3:01:00 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	66.000	4.000	100.000
Column G	144	0	8.000	0.000	40.000

Mann-Whitney U Statistic= 769.500

T = 1993.500 n(small)= 18 n(big)= 144 ($P = 0.004$)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference ($P = 0.004$)

t-test Monday, April 20, 2009, 3:09:27 PM

Data source: Dardenne Creek #3 vs All Controls--Visual Estimation Method

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 3:09:27 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	93.250	37.500	100.000
Column F	144	0	17.500	0.000	76.250

Mann-Whitney U Statistic= 728.500

T = 2034.500 n(small)= 18 n(big)= 144 (P = 0.002)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.002)

t-test Monday, April 20, 2009, 3:20:49 PM

Data source: Dardenne Creek #3 vs All Controls--Pebble Count Frame Method

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 3:20:49 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	90.000	28.000	100.000
Column G	144	0	8.000	0.000	40.000

Mann-Whitney U Statistic= 609.500

T = 2153.500 n(small)= 18 n(big)= 144 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

t-test Monday, April 20, 2009, 3:22:26 PM

Data source: Dardenne Creek #4 vs All Controls--Visual Estimation Method

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 3:22:26 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	92.750	15.000	100.000
Column F	144	0	17.500	0.000	76.250

Mann-Whitney U Statistic= 748.500

T = 2014.500 n(small)= 18 n(big)= 144 (P = 0.003)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.003)

t-test Monday, April 20, 2009, 3:23:58 PM

Data source: Dardenne Creek #4 vs All Controls--Pebble Count Frame Method

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 3:23:58 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	100.000	76.000	100.000
Column G	144	0	8.000	0.000	40.000

Mann-Whitney U Statistic= 401.500

T = 2361.500 n(small)= 18 n(big)= 144 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

t-test Monday, April 20, 2009, 3:26:40 PM

Data source: Dardenne Creek #4.1 vs All Controls--Visual Estimation Method

Normality Test: Failed ($P < 0.050$)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 3:26:40 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	7.500	0.000	100.000
Column F	144	0	17.500	0.000	76.250

Mann-Whitney U Statistic= 1346.000

T = 1417.000 n(small)= 18 n(big)= 144 ($P = 0.789$)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference ($P = 0.789$)

t-test Monday, April 20, 2009, 3:28:25 PM

Data source: Dardenne Creek #4.1 vs All Controls--Pebble Count Frame Method

Normality Test: Failed ($P < 0.050$)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 3:28:25 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	10.000	0.000	60.000
Column G	144	0	8.000	0.000	40.000

Mann-Whitney U Statistic= 1242.500

T = 1520.500 n(small)= 18 n(big)= 144 ($P = 0.771$)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference ($P = 0.771$)

t-test Monday, April 20, 2009, 3:30:14 PM

Data source: Dardenne Creek #5 vs All Controls--Visual Estimation Method

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 3:30:14 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	5.000	0.000	17.500
Column F	144	0	17.500	0.000	76.250

Mann-Whitney U Statistic= 1633.000

T = 1130.000 n(small)= 18 n(big)= 144 (P = 0.069)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.069)

t-test Monday, April 20, 2009, 3:45:01 PM

Data source: Dardenne Creek #5 vs All Controls--Pebble Count Frame Method

Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 3:45:01 PM

Data source: Excel 1 in Sediment_Estimates

Group	N	Missing	Median	25%	75%
Column H	18	0	0.000	0.000	4.000
Column G	144	0	8.000	0.000	40.000

Mann-Whitney U Statistic= 1694.500

T = 1068.500 n(small)= 18 n(big)= 144 (P = 0.028)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.028)

t-test Monday, April 20, 2009, 3:46:59 PM

Data source: Dardenne Creek #6.1 vs All Controls--Visual Estimation Method

Normality Test: Failed ($P < 0.050$)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 3:46:59 PM

Data source: Excel 1 in Sediment_Estimates

Group	**N**	**Missing**	**Median**	**25%**	**75%**
Column H	18	0	83.750	72.500	98.000
Column F	144	0	17.500	0.000	76.250

Mann-Whitney U Statistic= 634.500

T = 2128.500 n(small)= 18 n(big)= 144 (P = <0.001)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

t-test Monday, April 20, 2009, 3:48:37 PM

Data source: Dardenne Creek #6.1 vs All Controls--Pebble Count Frame Method

Normality Test: Failed ($P < 0.050$)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Monday, April 20, 2009, 3:48:37 PM

Data source: Excel 1 in Sediment_Estimates

Group	**N**	**Missing**	**Median**	**25%**	**75%**
Column H	18	0	42.000	16.000	80.000
Column G	144	0	8.000	0.000	40.000

Mann-Whitney U Statistic= 744.000

T = 2019.000 n(small)= 18 n(big)= 144 (P = 0.003)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.003)

t-test Friday, February 06, 2009, 10:38:38 AM

Data source: Visual Sediment Estimation Method versus Pebble Count Frame Method--All Stations
Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Friday, February 06, 2009, 10:38:38 AM

Data source: Excel 1 in Sediment_Estimates

Group	**N**	**Missing**	**Median**	**25%**	**75%**
Column B	270	0	38.750	5.000	100.000
Column C	270	0	24.000	0.000	92.000

Mann-Whitney U Statistic= 32202.500

T = 77282.500 n(small)= 270 n(big)= 270 (P = 0.017)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference (P = 0.017)

t-test Friday, February 06, 2009, 10:44:45 AM

Data source: Visual Sediment Estimation Method versus Pebble Count Frame Method--Dardenne Creek Stations
Normality Test: Failed (P < 0.050)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Friday, February 06, 2009, 10:44:45 AM

Data source: Excel 1 in Sediment_Estimates

Group	**N**	**Missing**	**Median**	**25%**	**75%**
Column B	126	0	80.000	10.000	100.000
Column C	126	0	60.000	4.000	100.000

Mann-Whitney U Statistic= 7499.500

T = 16377.500 n(small)= 126 n(big)= 126 (P = 0.437)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.437)

t-test Friday, February 06, 2009, 2:43:35 PM

Data source: Visual Sediment Estimation Method versus Pebble Count Frame Method--Control Stations

Normality Test: Failed ($P < 0.050$)

Test execution ended by user request, Rank Sum Test begun

Mann-Whitney Rank Sum Test Friday, February 06, 2009, 2:43:35 PM

Data source: Excel 1 in Sediment_Estimates

Group	**N**	**Missing**	**Median**	**25%**	**75%**
Column F	144	0	17.500	0.000	76.250
Column G	144	0	8.000	0.000	40.000

Mann-Whitney U Statistic= 8690.500

T = 22485.500 n(small)= 144 n(big)= 144 ($P = 0.016$)

The difference in the median values between the two groups is greater than would be expected by chance; there is a statistically significant difference ($P = 0.016$)